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EVERYTHING PNEUMATIC.

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FIG. I. JACKHAMER, AUTOMATICALLY ROTATED, DRILLING HORIZONTAL HOLES IN SLATE.

THE YOUNGER GENERATION OF ROCK DRILLS

BY CHAS. A. HIRSCHBERG.

One of the most useful additions to the rock drill family in recent years is the perfected hand hammer drill, known in various mining sections by different terms of endearment, such as the "Plugger" drill, "Jap" drill, "Jackhamer," etc.

This general type of drill is now extensively employed for such purposes as sinking shafts, digging trenches, drilling out ledges in road work, trimming tunnels, breaking up boulders, quarry work, stripping coal land, picking coal bands, tearing up pavements, foundation work, "glory-hole" mining, etc.

The hand hammer drill is essentially a one-man machine, its weight being 20 to 50 lbs., and this has brought the type into general popularity. This is aside from the fact that the hand hammer drill may be used in restricted quarters, and that more drills may be employed per unit of space due to the absence of mounting and the elimination of helpers.

The adoption of such unmounted drills has been accomplished without any sacrifice of speed; on the contrary, they have proved a material aid in securing results greater than could be obtained with other types, and this is

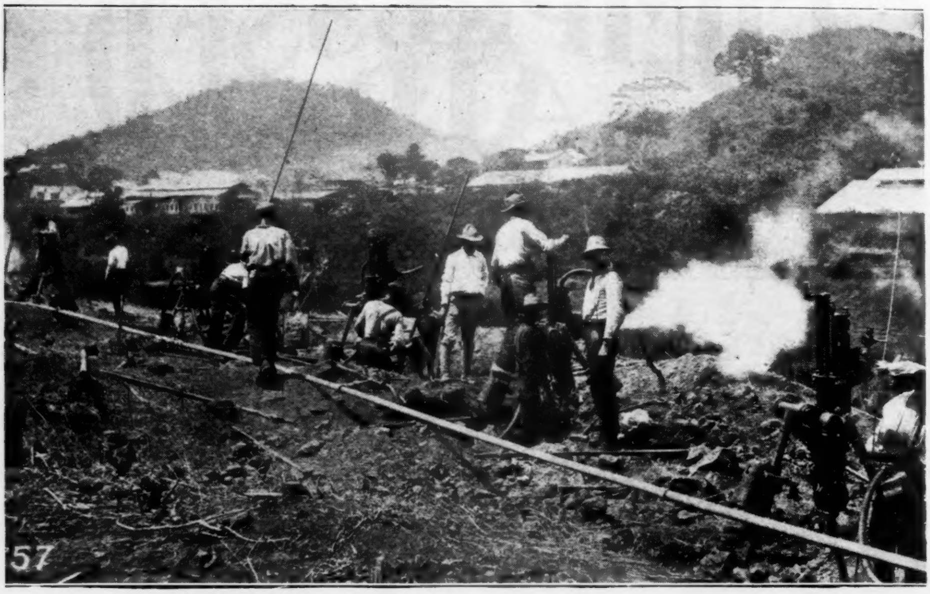


FIG. 2. INGERSOLL-RAND MOUNTED DRILLS ON PANAMA CANAL.

leaving out of consideration certain other advantages inherent in the hand type. It must be kept in mind, however, that this article applies only to work for which the hand hammer type is adapted. There are certain limitations to the possibilities of the type, which will be referred to later.

The time factor in drilling may be considered as made up of the following elements:—

Setting up the drill.
Drilling the hole.
Shifting position.
Removal.

SETTING UP THE DRILL.

The type of drill of which this article treats is used without mounting. Hence the element of time in this regard is eliminated.

DRILLING THE HOLE.

The element of time consumed in drilling the hole may be said to depend upon the size of the hole to be drilled, the method of applying the power to the bit, the facility with which steels may be changed and the manner in which the drill hole is kept clean of cuttings.

With the types of mounted drills in which steel reciprocates with piston, it is necessary to employ steels of large diameter, with correspondingly large bits, owing to the heavy crushing nature of every blow and the severe shocks to which the steel is subjected. Moreover a certain amount of power is consumed in the rubbing of the bit against the walls of the hole, which results in very rapid wear of the bit unless sufficient metal is provided.

In contrast to this, the type of drill under discussion employs the hammer principle for delivering the blow. The steel is not reciprocated with the piston, but rests loosely in the chuck and is struck a great many light blows by a rapidly moving piston, the bit end of the steel being at all times against the rock. It will be evident that the longitudinal movement of the steel is very slight (the rebound only) as compared to the reciprocation of several inches with the mounted type. With the hand type, the great reduction of rubbing of the bit against the walls of the hole reduces the wear on the wings of the bit, so that bits of smaller gauge variations may be employed. In other words, to obtain a given size of hole at the bottom, a smaller size of starter bit may be employed than would be advisable with the mounted type of drill. In the one type (Fig. 3) the steel is rigidly clamped to the piston rod; in the other it rests loosely in the chuck and is prevented from going too far into the cylinder by a collar on the shank of a steel or by means of an anvil block (Fig. 4) interposed between the end of the steel and the piston. The latter constructions mean less

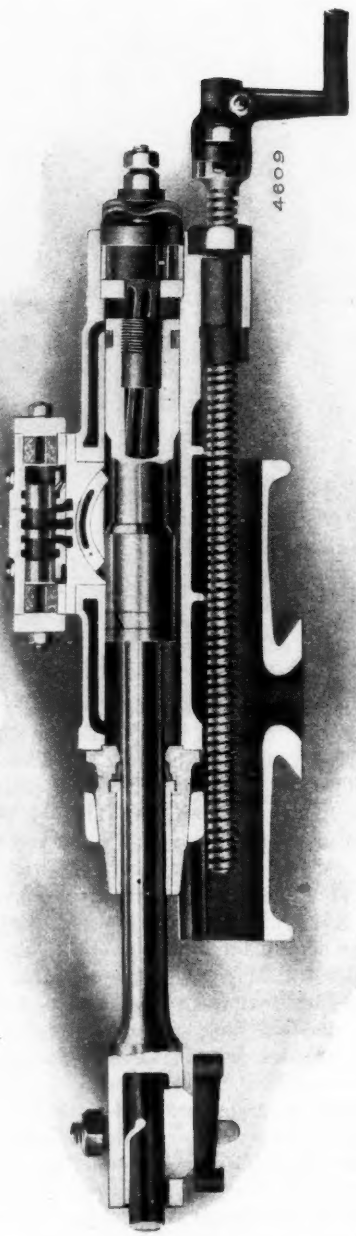


FIG. 3. SECTION OF MOUNTED TYPE OF DRILL.

time consumed while changing steels and in removing steels so as to clean the hole. Of course, with types of drills having automatic hole-cleaning features (Figs. 5 and 8) the time consumed in cleaning the hole may be practically eliminated from consideration.

The time required for removing the steel from the hole is still further reduced when a steel holder (Figs. 5 and 6) is employed, especially if it is of a type that can be slipped into place quickly.

In the mounted type the steel is invariably automatically rotated. In the hand type there are two methods of rotation, by hand and automatically. Figure 7 illustrates a drill of the hand-rotated type in operation. The drill runner must constantly rotate the drill back and forth through an angle of about 45 deg. or the hole will become rifled, with consequent sticking of the steel and delay in removing it. Figure 1 illustrates the self-rotating type in operation and Figure 8 shows the rotating mechanism. It is apparent that a drill embodying automatic rotation will produce a more uniform hole and will relieve the operator of the most irksome part of his work, thus permitting him to work faster and feeling little or no necessity for periods of rest.

SHIFTING POSITION.

The time required for mounting and for the various operations of shitfing mounted types of drills is often greater than the actual time of cutting, whereas with the hand hammer drill this element is practically eliminated, it requiring but a few seconds to shift.

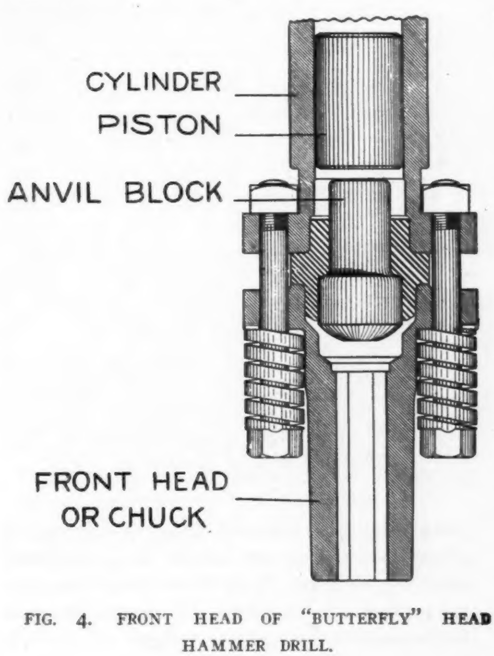


FIG. 4. FRONT HEAD OF "BUTTERFLY" HEAD HAMMER DRILL.

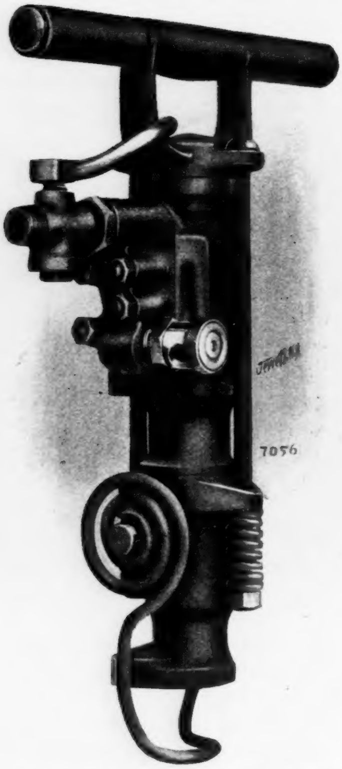


FIG. 5. SHOWING SPECIAL VALVE FOR DIRECTING THE AIR THROUGH THE HOLLOW STEEL.

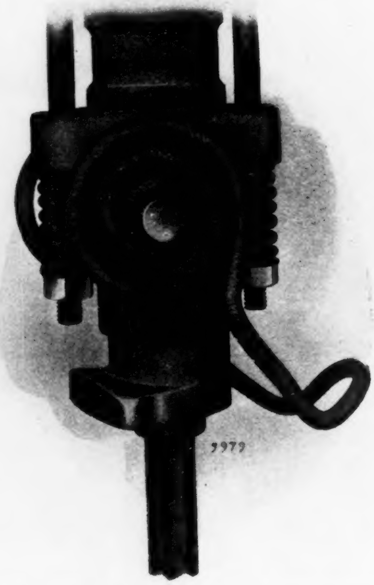


FIG. 6. STEEL HOLDER SPRING UNFASTENED.

REMOVING THE DRILL.

When it comes to removing the equipment preparatory to blasting, the absence of mounting, aside from the great disparity in weight (about 250 pounds as against about 40 pounds) is an important item in favor of the new type of drill.

LIMITATIONS OF THE HAND TYPE OF DRILL.

Of course this type of drill has its limitations, principal among which is the depth of hole that may be drilled economically. This varies, depending solely upon the nature of the ground to be drilled. In extremely hard rock the drilling range has been as low as 5 or 6 feet, in medium ground around 12 feet, and in favorable ground around 20 feet.

RECORDS OF ACCOMPLISHMENT.

As might be expected from the foregoing discussion, the actual record of accomplishment has been greatly in favor of the "younger generation" of rock drills for classes of work falling within their proper range.

ROOSEVELT DRAINAGE TUNNEL

This tunnel now completed, was built to drain the mines at Cripple Creek, Colo., and enable the mines to be sunk to greater depths, while eliminating the heavy cost of pumping. The tunnel is about four miles long, 10 ft. wide and 6 ft. high, with a ditch 3x6 ft. along one side of the floor. No lining was necessary, the tunnel being driven in very hard granite, which made drilling difficult, and made it impossible to break the ground to the bottom of the drill holes. The granite forms a great basin filled with fissured volcanic rock in which the mines are sunk and which is full of water. The original water level was about 1200 ft. above the level of the tunnel. The success of a tunnel in draining the El Paso mine in this district led to the cooperation of mine owners in driving the Roosevelt tunnel for the drainage of the entire district, this tunnel being 1500 to 2000 ft. beneath the surface. A drill hole from the bottom of the El Paso shaft with the tunnel served to drain that mine, and lateral drifts were run to tap different underground water courses or pockets. The present flow is from 7000 to 8000 gal. per min., and the water level in the volcanic rock is being lowered at the rate of about 100 ft. per year.

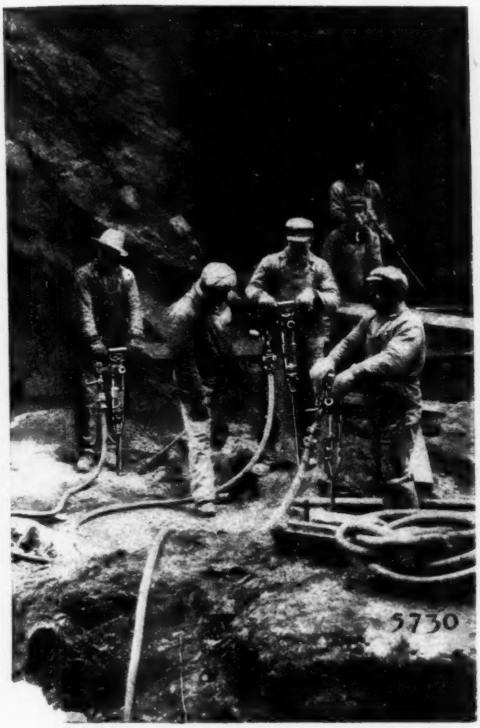


FIG. 7. HAND ROTATED BUTTERFLY DRILLS AT GRAND CENTRAL TERMINAL, NEW YORK CITY.

SELF-IGNITING TEMPERATURES

Experiments of Dr. H. Holm have determined that the temperatures at which substances in contact with atmospheric air at ordinary pressures will take fire are, among others, as follows: Lighting gas, 1110 Fahr.; benzine, 780; petroleum, 716; gas oil, 660; machine oil, 716; coal tar, 932; tar oil, 1075; benzol, 968. These temperatures are greatly influenced by the presence of other substances, which act as catalysers. This is especially the case with hydrogen, methane and ethane, not ethylene or acetylene. Among solids it is the substances with the biggest molecules which most readily burst into flame. As a broad rule, the nearer a substance is to a gaseous condition, the higher the temperature to which it must be exposed before it will kindle.

One of the officers of a certain company recently dictated 296 words for an important telegram. An efficient and careful stenographer boiled it down and fully and concisely covered everything with 91 words.

AIR CONSUMPTION AND MAINTENANCE COST OF ROCK DRILLS

BY CHAS. C. HANSEN.

A number of tests of rock drills are published from all parts of the world dealing especially with Air Consumption and Maintenance Cost. Much of this literature is interesting to read, but some of the information is misleading owing to the fact that so many important factors are left out of the calculation.

If it was possible to establish a definite test that would be equally applicable to all classes and conditions of rock drilling work, and quarry conditions, these test runs would be very instructive. Unfortunately this is not possible; the rock will vary in hardness or resistance to penetration of the drill; even in the same locality different kinds of rock will be found; the air pressure is not constant, and the skill or personal equation of the drill runner is also to be considered. Another important factor in determining the amount of work done by the machine, is the condition of the drill bit; that is, the shape of the bit and the tempering.

It is therefore apparent that these tests are only useful for local comparison, and even here the result may be misleading. This is also true about the cost of up-keep on the machine; the handling, or rather the mishandling, of the drilling machine is largely responsible for high cost of up-keep, but when we consider that the average drill runners of to-day are very inferior men, practically on a par with the average pick and shovel men, it speaks high for the rock drill machines as built to-day, that the average cost of repair is still not unreasonable.

In considering the different rock drill designs the aim has been to produce a machine that will stand this rough handling and yet be of not too great weight, so that it can be easily handled and can be operated properly under the most adverse conditions, with air pressure ranging between 90 and 45 lbs., be simple in construction and yet as economical in air consumption as these adverse conditions will permit.

So much for the manufacture of the mining machine. The other factor to be considered is the condition of the drill steel used, which is altogether in the hands of the mining engineers or mine managers. In some cases

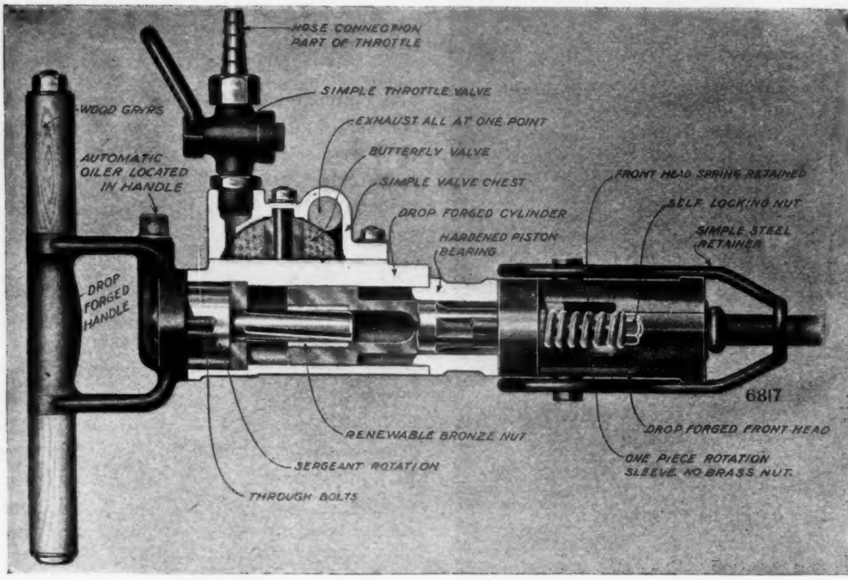


FIG. 8. SECTION OF JACKHAMER WITH AUTOMATIC ROTATION.

the steel question is receiving proper attention; in the majority of cases, however, the steel condition is left to the blacksmith. If he cannot produce the result he is usually fired and somebody else is hired, which may or may not improve the situation. How many mine managers and quarry men pay the necessary attention to the steel conditions? That is to the proper material and to the proper sharpening and tempering of the bit. The shape of the bit largely determines the drilling speed, as the different peculiarities in the rock will require different shape and temper to give the best results. A number of instances have come to the writer's attention in which the changing of either the shape of the bits or the tempering has doubled or trebled the amount of the drilling.

Also it is patently wrong to base the air consumption of an isolated group of drills, or any one drill, on the amount of air used in a shift, without basing this air consumption on the number of lineal feet of hole drilled in the same time.

RULES FOR DRILL TESTS.

It seems only reasonable that tests of a Rock Drill should include the following data:

First, air required for drilling a given depth of hole of a given size in the shortest possible time.

Second, weight of drill, convenience in setting up and changing steels.

Third, cost of repair for a given time.

Fourth, the continued efficiency of a machine over a reasonable length of service, both in air consumption and in drilling accomplished.

In the first item will enter the wages for drill runners and helpers, which, after all, is the largest detail of expense in drilling rock. This will also take proper account of the air consumption. In the second item will also enter the wages for drill runners and helpers, as it will affect the amount of work done in a day or shift; that is, this data will determine to a large extent the percentage of time the drills are actually drilling rock. In the third will enter the construction details of the machine, and its ability to run without excessive cost in repairs. In the fourth will enter the construction details as well as workmanship and material of the different parts, as well as wages for drill runners and helpers, also the air consumption, not only for a test run, but for continuous work.

On the efficiency of the man in charge will depend whether the holes are placed properly to get the best results, and whether the machines are handled to their utmost capacity,

with proper shape and temper of drill bits. On him will also depend the proper handling of the machines, such as oiling and care, that no unnecessary breakage occurs from rough and careless handling. -

The man in charge should know that the machines are handled properly and the steel and bits are of proper shape and temper. Next will come the amount of rock that can be broken per lineal foot of hole drilled, which will depend on whether the holes are pointed or placed at the most economical spacing for producing the best result, and that these holes are loaded with the proper explosives of the proper quantity to give the maximum efficiency. When it comes down to actual figures the mining engineer or hard rock man should figure his cost per cubic yard, or ton of rock broken. In this figure will enter all the charges against this rock, such as labor for drilling and mucking, amount of air used, cost of sharpening steels, maintenance of equipment and the cost of explosives.

It is good business to pay strict attention to the air consumption of the drilling machine, but do we often find the proper attention paid to leaky pipe lines? This loss will in many cases amount to from 25 to 50 per cent of the air consumed in the drills, depending on the condition of workings, whether the pipe lines are getting the proper attention, leaks are guarded against and joints are remade when they have been damaged. Too often this part of the work is slighted or neglected, and perhaps not tackled until compelled by absolute necessity.

Drilling rock is, after all, a business which should have the proper attention in all its various details to give the most economical result.

When steam escapes you can generally see it or hear it, when there is a leak in an ammonia pipe line that also is immediately evident, but a leak in a compressed air line entailing an appreciable loss may go for a long time unnoticed, not that it is more difficult to make the air line tight, and to keep it tight, than the others. An Illinois manufacturer at regular intervals puts essence of pepperment into the air system and then has all the pipes inspected for leaks. If the slightest amount of air escapes anywhere it is revealed by the odor.

VAPOR IN COMPRESSED AIR

BY A. HOFFMAN.

Every user of compressed air knows that moisture in air is to be avoided, if possible, when the air is used in pneumatic tools, drills or, in fact, in any reciprocating mechanism. It is also generally known how the trouble due to moisture is brought about; namely, by the vapor condensing while expanding in the air-operated tool. The drop in temperature which takes place during the expansion causes the water formed to freeze, clogging up the passages of the mechanism, or if actual freezing does not take place, at least the water formed washes out the lubricant, causing the tool to wear out rapidly. The usual method of eliminating moisture from compressed air is by cooling the air after it leaves the compressor, thus depositing a portion of the moisture before it enters the pipe lines, and one of the objects of this article is to show just how effective an aftercooler is in removing this moisture at different degrees of cooling.

MOISTURE REMOVED BY AFTERCOOLER.

Atmospheric air always contains a certain amount of moisture and this exists as a vapor or steam gas, and when present in the air it behaves in every way like steam; it exerts a pressure, the amount of which depends upon the temperature and the quantity of moisture present. At a given temperature air can hold a fixed maximum weight of moisture and when it contains this maximum amount the air is said to be saturated. Air containing moisture behaves in accordance with Dalton's law on mixture of gases, that is, each gas or vapor in a mixture exerts its own pressure and the total pressure of the mixture is the sum of the pressures exerted by the gases independently. Thus, take atmospheric air at 80 deg. F., if the air is saturated with moisture the pressure exerted by the vapor will be the pressure of saturated steam at a temperature of 80 deg. F., which is according to any steam table 0.505 lb. per sq. in. abs. Therefore, if the total pressure of the atmosphere is 14.7, the pressure exerted by the air must be 14.7 less 0.505, which equals 14.195 lb. per sq. in. If, now, instead of being saturated the air contains only 70 per cent. of the maximum amount it can hold, that is to say, the relative humidity of the air is 70 per cent.; then the pressure exerted by the vapor would have been only

$$0.7 \times 0.505 = 0.3535$$

and the pressure exerted by the air would be

$$14.7 - 0.3535 = 14.3465$$

When the mixture of air and vapor enters a compressor the vapor again behaves like any gas, that is, it is compressed adiabatically with the air. The vapor then becomes in every sense a steam gas and at the end of compression it is highly superheated, and only by reducing its temperature can the vapor be deposited as water. *Vice versa,* when compressed air containing this vapor is used in any mechanism where it is expanded, the vapor or steam gas is expanded adiabatically, and as every engineer knows when steam is expanded in this way a temperature reduction takes place and a portion of the steam is condensed, and it is this condensation which causes so much annoyance in the air-operated tool.

The volume of vapor which any volume of air contains can be calculated from the following simple formula:

$$Vs = \frac{Vps}{p}$$

where

Vs = Volume of vapor in cubic feet at pressure p,

V = Volume of air and vapor in cubic feet at pressure p;

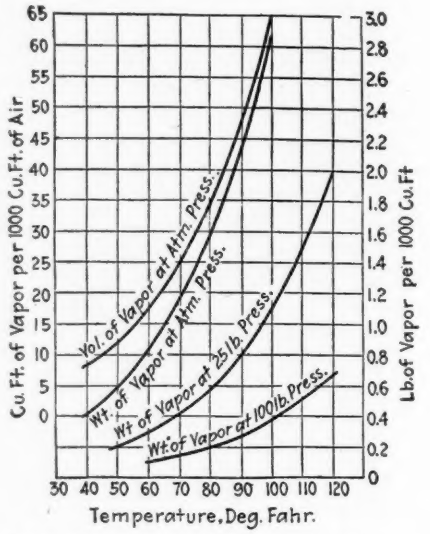
p = Absolute pressure of air and vapor per square inch; thus at sea level and atmospheric conditions $p = 14.7$;

ps = Absolute pressure per square inch exerted by the vapor.

Thus, if the mixture is saturated ps equals the pressure of saturated steam obtained from a steam table at the temperature under consideration.

The weight of vapor present will be $V \times D$, where D is the weight of vapor per cubic foot and if the air is saturated D equals the weight per cubic foot of saturated steam taken from a steam table at the temperature in question.

In the accompanying diagram is shown the volume of vapor in cubic feet which 1000 cu. ft. of air contains at atmospheric pressure when saturated and at different temperatures. Thus, if the temperature of air is 80 deg. F., the pressure exerted by the vapor is 0.505. The volume Vs of the vapor is according to the above formula:



VAPOR IN AIR AT DIFFERENT PRESSURES AND TEMPERATURES.

$$\frac{1000 \times 0.505}{14.7} = 34.3 \text{ cu. ft.}$$

And this is the quantity also shown by the diagram.

Curves are also given showing the weight of vapor which 1000 cu. ft. of air at atmospheric pressure, 14.7 lb. per sq. in., can hold at different temperatures as well as the vapor which 1000 cu. ft. of free air can contain at 25 lb. gage pressure and 100 lb. gage pressure per square inch. Thus at 60 deg. F. the weight of vapor is 0.8 lb. at atmospheric pressure and at 80 deg. F. it is nearly 1.6 lb. or twice that at 60 deg. From these diagrams it can be determined exactly how much vapor remains in the air after being compressed and then cooled in an aftercooler. For instance, if air is taken into a compressor at 80 deg. F. and if it is saturated with vapor, 1000 cu. ft. of air will contain 1.6 lb. of vapor, and if the humidity is 70 per cent., the amount of vapor will be

$$0.7 \times 1.6 = 1.12 \text{ lb.}$$

If, now, this air is compressed in a two-stage compressor to 100 lb. discharge pressure, the intercooler pressure will be about 25 lb. If water is supplied the intercooler at 60 deg. F., the air will leave the intercooler at about 80 deg., and the amount of vapor 1000 cu. ft. of air at 25 lb. pressure can contain is found

from the diagram to be nearly 0.6 lb. In other words, 1.12 lb. less 0.6 equals 0.5 lb. of vapor has been removed by the intercooler, or 45 per cent. of the moisture originally in the air. If, now, the air leaves the compressor at 100 lb. pressure and is cooled in an after-cooler to 80 deg. F., the diagram shows the moisture still in the air to be 0.2 lb., or 18 per cent. of what vapor was there originally, that is, the intercooler has removed 45 per cent. and the aftercooler 36 per cent. of the vapor.

If instead of cooling the air in the after-cooler down to 80 deg. it had been cooled down to 60 deg., the vapor remaining would only have been 0.1 lb., or 9 per cent. of what it originally contained, and this shows the great importance of cooling the air down to the lowest possible temperature. In the case just cited, by cooling 20 deg. lower, that is, from 80 to 60 deg., one-half of the moisture the air contained was eliminated. Take another example. If the air enters the compressor at 60 deg. F. and 70 per cent. humidity, it will contain about 0.56 lb. of moisture, and if on account of insufficient cooling surface the air can be cooled down to only 110 deg. in the aftercooler, practically all of the moisture originally in the air will remain after it has been compressed to 100 lb.

In order then to get all but a small percentage of the vapor out of the air it must be cooled to a low temperature. It is impossible to remove all of the moisture and if the air is used at the same temperature as it leaves the cooler, it will be saturated with moisture and water will deposit when expansion takes place in the tools. To entirely prevent the deposit of moisture, the air must be cooled to a much lower temperature than that at which it enters the tools, or what amounts to the same thing, the air must first be cooled and then reheated before it is used.

MOISTURE CAUSES LOSS OF WORK.

There is another phase of this question to be considered. That is, how does the moisture in the air affect the work done by the compressor? It has already been stated that the vapor must be compressed the same as the air; therefore, the work required to compress the vapor must be considered as lost work since the vapor is eventually practically all deposited as water in the intercooler, aftercooler or pipe lines, and does no work in the tools. For instance, with 1000 cu. ft. of air entering the compressor at 80 deg. F. and 70 per cent. humidity, as before, the vapor will occupy a volume of 34.3 cu. ft. at saturation or

$$0.7 \times 34.3 = 24 \textit{ cu. ft.}$$

at 70 per cent. humidity. This is equal to 2.4 per cent. of the total volume of 1000 cu. ft. In other words, the volumetric loss due to vapor is 2.4 per cent. If compression takes place in one stage to 100 lb., the work required to compress 24 cu. ft. of vapor will also be 2.4 per cent. of the total work, or 2.4 per cent. represents the work lost in compressing the vapor. If compression takes place in two stages, the loss is a little less because the vapor that is removed by the intercooler does not have to be compressed in the high-pressure cylinder. Calculation shows in the above case for two-stage compression that the lost work will be about 2 per cent. If the air enters the compressor at 100 deg. F. and 80 per cent. humidity, the same reasoning shows that with single-stage compression the lost work is about 5 per cent. and with two-stage compression about 4 per cent.

This is a loss in compression of air ordinarily not considered. It is true that most users of air compressors know the importance of taking air into the compressor at as low a temperature as possible, and the reasons, of course, are that by so doing a greater weight of air is compressed with a given amount of power expended. In addition to this the air should be taken into the compressor as cold as possible so as to reduce the lost work due to compressing the vapor. For instance, if the air is taken from a warm engine room close to 100 deg. temeprature and laden with moisture, the figures show that the loss due to compressing moisture may be as high as 5 or 6 per cent. of the total work done.

COOLING WATER REQUIRED BY WATER VAPOR.

Finally, there is one other question to be considered in connection with moisture in the air; that is, what percentage of the total water supplied to the intercooler or aftercooler is used to cool and extract the vapor in the air. Suppose, as before, the air enters the compressor at 80 deg. F. and 70 per cent. humidity, then if the temperature of the air leaving the low-pressure cylinder in a two-stage compressor is 250 deg., and the air is cooled down to 80 deg. F. in the intercooler,

the volume of air and vapor being 1000 cu. ft., the volume of vapor alone is 24 and the volume of air is 976 cu. ft. The weight of this air will be 71.8 lb. and the heat extracted from the air will be the weight multiplied by its specific heat and by the reduction of temperature; that is,

$$71.8 \times 0.237 \ (250 - 80) = 2893 \ B.t.u.$$

The weight of the vapor contained in the air as before is 1.12 lb. This must be cooled from 250 to 80 deg., and as the specific heat of the vapor is about 0.46, the heat extracted will be

$$1.12 \ (250 - 80) \ 0.46 = 87 \ B.t.u.$$

To this must be added the latent heat of the 0.5 lb. of vapor which is actually deposited in the cooler. The latent heat of steam at 0.5 lb. abs. pressure is 1046, which, multiplied by 0.5 gives 523 B.t.u. The total heat, therefore, given up by the vapor will be

$$87 + 523 = 610 \ B.t.u.$$

and the entire heat removed by the water in the cooler contained both in the air and the vapor will be

$$2893 + 610 = 3503 \ B.t.u.$$

In other words, of the total heat extracted 610 B.t.u., or 17.4 per cent., is taken from the vapor in the air; namely, 17.4 per cent. of the water used is required by the vapor—a most surprising result.—*Power.*

STREET FLUSHING BY PNEUMATIC METHODS

BY CHARLES C. PHELPS.

Modern medical science has taught us the dangers of unclean streets. The antiquated method of sprinkling streets by watering carts keeps down the dust to a certain extent, adding to the comfort of the inhabitants and reducing losses from injury to furnishings, stocks of merchandise, etc., but it cannot be said to cleanse, for it simply moistens and spreads the refuse on the surface and in the crevices, thus hastening decay and furnishing ideal conditions for the propagation of disease germs. When the streets become dry, the dust raised by the winds or in sweeping acts as a carrier for these germs. It is generally believed that many of the diseases of the lungs and tissues of the breathing passages are spread in this way. In many municipalities the flushing action of the rain and melting snow is the only real cleansing which the streets ever receive.

Some cities have abandoned cart sprinkling for flushing direct from the hydrants. Where the water supply is plentiful and hydrants are conveniently spaced, this system has many advantages.

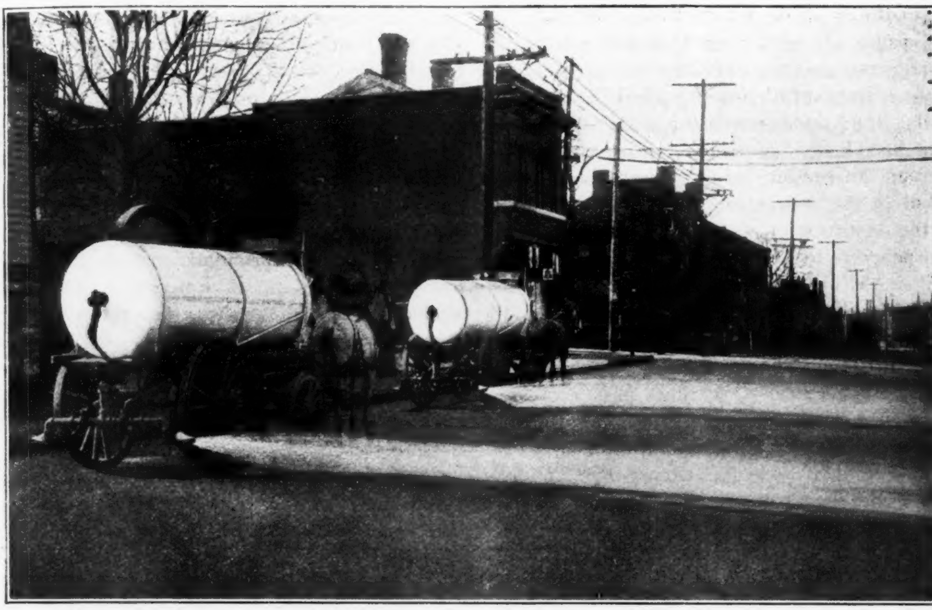
Another system, by pneumatically operated flushing wagons, has been successfully adopted in a number of localities. While the system has been in operation for perhaps eight or ten years, only during the past three years or so has it been used extensively in this country. A large number of these wagons are employed in such cities as Chicago, Washington, Cleveland, Cincinnati, St. Louis, Kansas City, Salt Lake City and Atlanta, as well as in a large number of smaller cities.

The pneumatic system does not work so satisfactorily on water systems having a too low pressure. Twenty-five pounds per square inch is about the practical minimum pressure to give the jet sufficient force. Higher water pressures, however, are being adopted by many

PNEUMATIC STREET FLUSHER.

cities to meet modern requirements (a notable case being New York's new system, which will carry a pressure of about 200 pounds per sq. in.), so that the field for pneumatic flushing will undoubtedly be widened as its advantages become known.

A successful flusher of the pneumatic type is shown in the accompanying illustration. It is made by the Sanitary Street Flushing Co., of St. Louis. The sheet steel tank is divided into two parts, the air chamber in front, and the water compartment of about 600 gallons capacity in the rear. The air compartment occupies about one-quarter or more of the entire tank, depending upon the working pres-



PNEUMATIC STREET FLUSHERS IN WASHINGTON, D. C.

sure. These two compartments are connected by piping on top of the tank. There are three valves in this pipe, a pop safety valve, a rear globe valve connecting with the atmosphere and the forward angle valve for disconnecting water and air sections. A gauge is mounted on the rear end of the tank. The outlet pipe leading to the fan-shaped flushing nozzles is connected to a water seal tank under the rear end of the wagon.

The machine must be charged, initially, as follows: After closing the rear valve to the atmosphere and opening the valve between the two compartments, the hose is attached to the hydrant and the machine is filled with water until the air gauge registers about 80 per cent. of the pressure on the hydrant; for example, if the city water pressure is 60 lbs., which is the maximum working pressure of the flusher, then the hydrant should be turned off when the gauge registers 48 pounds. The forward valve is then closed, which will hold the compressed air in the air chamber. The flushing heads are opened and also the rear valve. The rear chamber empties of water, and fills with air through the rear valve. After the first charge of water has been discharged, the filling operation is repeated, the air tank taking up whatever pressure there may be on the hydrant (60 pounds in the example cited above). This completes the operation of charging the machine with the initial air pressure, which suffices for several water loads.

The flushing nozzles are operated by levers from the driver's seat. The air pressure on top of the water causes a stream of considerable force to be projected at a uniform angle against the street surface. These wagons are adapted for sprinkling as well as flushing, by substituting a special form of nozzle.

Some form of low water valve may be installed to prevent the tank emptying completely and so losing its air pressure. The tank is filled as often as desired thereafter without any further manipulation of the valves on top of the tank, in the same manner as an ordinary sprinkling cart. The air chamber, as hinted above, need not be recharged again for some time, but will have to be recharged occasionally as the air pressure gradually diminishes due to absorption by the water and possible leakage.

In Washington, an initial air pressure of about 40 lbs. is used. One tank full flushes about 450 square yards of surface in a strip about 8 feet wide. In Chicago, each machine covers about 22,000 square yards of surface each night, throwing about 1.25 gallons on each square yard. An air pressure of 32 pounds is normally carried.

ECONOMIZING WITH ROCK DRILLS

A paper giving the methods and results of economizing in the consumption of air and in the maintenance costs of rock drills in some of the Rand mines presented by Messrs. E. G. Izod and E. J. Laschinger before the South African Institution of Engineers was published in the November issue of the Journal of the Institution. A considerable portion of this paper is here presented in abstract.

Since the air power used on the Rand is intended primarily for actuating rock drills, it is very important that the air consumption of these machines should be very thoroughly studied by engineers. In times past, economy in the use of compressed air was not considered very important, because it was in many cases absolutely essential to use this air for ventilation, as no other means of introducing fresh air to various parts of the mines existed. This state of affairs is now disappearing and the sooner compressed air is no longer required for ventilation the better. Adequate ventilation by compressed air is too expensive. We would record our conviction that comparatively little is known about rock drills, even by engineers who should know a good deal about them, and that if these machines had received a fraction of the thought and attention bestowed upon machine tools in the fitters', carpenters' and boilermakers' shops, the history of the development of the rock drilling machine would have been a very different story, and the machine itself would have attained a state of perfection and economy unknown to-day.

The mines under the control of the Central Mining and Investment Corporation, Limited, and the Rand Mines, Limited, purchase nearly the whole of their air power from the Rand Mines Power Supply Company, Limited. This air power is measured by air meters which were carefully calibrated before being installed and are under constant supervision and frequently checked. The air power is purchased on the basis of a "unit of compressed air," which represents energy to the extent of 0.641 of a kilowatt hour, which the weight of air in a "unit" will give out under isothermal expansion from its delivered pressure down to a nominal atmospheric pressure of 12.1 lbs. per square inch absolute. The small deficiency of air power not purchased, but required to make up the total requirements of the mines is generated by steam compressors, and the units of compressed air from these are calculated on the results of tests.

Against this consumption of air power, there is to be set the work done. Each mine keeps a record of the "machine shifts" worked underground by the rock drills of various makes and sizes and also a record of winches, pumps, etc., which are driven by compressed air. All these machines are then brought down to the standard rate of a 3¼-in. machine shift. This 3¼-machine shift standard represents the work that should be normally performed by a rock drill with a 3¼-in. cylinder working as usual during an eight-hour mining shift. With regard to the machine shifts actually worked in drilling rock, separate records are kept of stoping and development shifts on each mine.

It is well known that the amount of air consumed per development shift is greater than per stoping shift. By plotting the air consumption of each mine for each month per 3¼-in. machine shift in a position which corresponds to the ratio of development shifts to total shifts, points are obtained which show a mean line of air consumption and which indicate whether at any particular mine more or less air is being consumed than the average to be expected. The indications of such a plot show whether a mine is improving month by month and which mine or mines should have their conditions investigated for probable improvement of conditions.

From an examination of a sample plot so made it appears that in a mine where conditions are normal and care is exercised to prevent waste and to obtain economy in air, when there is no machine development work going on, about 80 units of air power would be required per 3¼-in. machine shift and with 50 per cent. of the drilling on development, about 120 units of air power per machine shift. From this it follows that on a development shift twice as much air is used as on a stopping shift. Since the purchased air is delivered at an average pressure of about 100 lbs. per square inch gage, an air unit represents as nearly as possible 440 cu. ft. of air at 12.1 lbs. per square inch absolute and 60 degrees F., i. e., free air on the Rand. Eighty air units per machine shift therefore represent 35,200 cu. ft. of free air per 3¼-in. machine shift, and the 120 units represent 52,800 cu. ft. of free air.

With regard to mines which take more air than the mean minimum states, one must not at once jump to the conclusion that air is being wasted. On mines with wide stopes where deep holes are drilled, more air is used per machine shift and yet with greater economy in so far as breaking ore is concerned; hardness of rock, width of stope, footage drilled and other factors enter into the problem. At the same time a high air consumption when shown on the comparative record should form the cause of a serious investigation. It is also undeniable, since the miners do not pay for the air they use, and because it is some trouble and requires extra care to save air, and to see that all joints are tight and hose in good repair, that there is need for constant care and supervision.

The fact that large savings in the air power bill of the mines may be effected by paying attention to this matter of air consumption is given by Table I, which shows a progressive diminution of the air power required on the mines of the Central Mining Rand Mines Group for 1912.

TABLE I.—TOTAL DRILL SHIFTS, TOTAL AIR UNITS AND UNITS PER DRILL SHIFT DURING PERIOD JANUARY TO DECEMBER, 1912.

Month.	Equivalent 3¼-in. machine drill shifts, including pumps and winches.	Total air units.	Units per drill shift.
January	73,926	12,018,587	163
February	69,887	11,072,207	158
March	78,887	12,555,015	159
April	75,980	11,272,770	148
May	81,548	11,919,934	146
June	73,839	11,287,577	153
July	82,252	11,561,971	141
August	81,161	11,333,228	140
September	75,581	10,832,301	143
October	80.510	11,339,470	141
November	79,862	11,037,958	138
December	78,545	10,813,549	138

The improvement as between January and December shows a saving of over one shilling (24 cts.) per machine shift in the air power cost.

The method of assessing work done by the arbitrary standard of the 3¼-in. machine shift is no doubt somewhat crude, but it was devised as a beginning for making comparisons to suit present conditions on the Rand. A thorough and true basis would be arrived at by measuring the air power consumed at each point where work is done and an exhaustive treatment of this investigation would certainly be rather expensive.

When it comes to the practical applications of investigations of avoidable losses and the compilation of statistics to show where improvement should be effected, a balance must be struck between the costs of obtaining the data and the amount of savings that can result.

AIR METERS.

We are strongly of opinion that separate air meters should be permanently installed on each working level of a mine and at each point where air is used for specific services. This would enable the engineer to find out at once where air was being wasted or used, in apparently excessive quantities. Strict investigation at particular points could then be carried out and leakage or waste hunted down to its source.

Whatever the make or type of drill, there is one point, however, which is common to all makes and which deserves the closest attention of the mechanical engineer at the mine. We refer to the condition of the drill as a machine. Every mechanical engineer at a mine is, or ought to be, responsible for the condition of the drill (mechanically considered) before it goes down the mine and for the repairs and renewals which are made from time to time.

It is true that the rock drill has rough work to do, is roughly handled by persons who, in many cases, have no mechanical knowledge and that it has to work under the severest conditions that test any machine and militate against economy over a prolonged period.

A DRILL REPAIR SYSTEM.

In this connection we must refer to the system of rock drill maintenance introduced some five or six years ago at the Village Main Reef Gold Mining Company, Limited, and for which our president (Mr. Calder) is mainly, if not solely, responsible. This system consists of bringing up every drill from underground to the rock drill fitting shop regularly, overhauling the drill thoroughly in all its parts and particularly in finishing up the cylinders with reamers, and grinding down the pistons to an accurate fit within a few thousandths of an inch, and thus standardizing cylinders and pistons. Besides this, a record is made of each machine in a book kept for the purpose, and when from the records it appears that a machine has been in the mine for longer than three months, that machine is brought to the

surface for overhauling, whether the miner likes it or not.

As the monthly records of air consumption compared with machine shifts at the Village Main Reef showed better results in regard to the use of air than those at other mines, tests on a practical scale were undertaken at various mines in order to judge whether the economy was due to the systems of rock drill in vogue at various mines.

The scheme of testing was to isolate machines at one level on certain mines where a considerable number of drills were working, to install a meter in the pipe serving these drills, and to take the necessary observations, particularly as to the running times of the drills, over a period of about a week in each case. From the figures thus obtained on various mines, fair average data were obtained showing the performances of drills in average condition for each mine, and indicating by comparison the relative efficiency of the state of repair of the drills. By measuring the air for the drills only, the results would not be obscured because of air being used for purposes other than drilling.

The measurement of the air was commenced at the time the first drill started working, and the air was no longer measured after the drills had finished their actual drilling shift, so that no error was introduced because of air being used to ventilate a drive before commencing or for blowing out the holes before charging. Tests were also conducted in each case to determine the leakage in pipes and hose, and this loss was deducted from the total air consumed per shift. The number of drills in the various tests varied from 10 to 16.

A short resume of the results of these tests is given in Table II. From this table it will be seen that the state of repair of the machines on the various mines is reflected, first in the great difference in relative air consumption at the various mines, and, secondly, in the case of the last two tests, the difference at the same mine between the machines in ordinary state of repair and after having been newly repaired for the purpose of comparison.

It will be within the recollection of many of the engineers on the Rand that the test conducted at the Meyer and Charlton in May, 1908, showed very clearly the enormous loss of air due to old machines, as compared with new machines of the same make, the difference in air consumption for the old being 60 per cent. more than for new machines. There does not appear to be any reason why a machine properly overhauled in the fitting shops should not be equal to a new one in so far as air consumption is concerned, if the cylinders, pistons and valves are properly fitted. An engineer who had had a steam engine overhauled, rebored the cylinders, fitted new pistons and rings and valve seats, would feel himself disgraced if the steam consumption figures showed worse than when the engine left the works.

TABLE II.

Mine.	State of repair of drills.	Cu. ft. air per min. of drilling time.	Relative consumption.	Aver. drill speed, ins. per min.
Village Main Reef.	Ordinary	103½	100	1.27
A......	Ordinary	122	118	1.20
B......	Ordinary	137	132	1.80
C......	Ordinary	153	147	1.29
C......	Newly repaired	120	116	1.30

In order that machines, either new or repaired, should be sent down the mine in good order and condition, it is advisable not only to run the machine on the block before sending it down, but also to test it for air consumption while on the block. A machine may seem in perfect order, giving high speed and an even beat, but the air consumption test may reveal a serious defect. Very useful data would be obtained also by testing the machines after coming up to be repaired, and before any work is done on them, that is if they are still in running condition.

DRILL REPAIRING BY CONTRACT.

On the Village Main Reef G. M. Company, Limited, a system had been in use for some years of placing the repair work of drills on contract, based on a certain price per 52 machine shifts, for which price the contractor, who is usually the rock drill fitter, had to be responsible for the purchase of spare parts, keeping drills in order, preventing waste of material, etc.

The cost of keeping the drills in order at the Village Main Reef was generally so much lower than the average that the Village Main Reef system was carefully investigated and a model form of contract was drawn up for the other mines. The contract system was then put into operation gradually on several of the other mines, and the results have been particularly satisfactory. The costs have fallen in

about 20 months from an average of $42 per 52 machine shifts to a figure of $27 per 52 machine shifts. The Village Main system, which after all, is a common-sense contract system, was slightly modified in one or two cases to suit different conditions on other mines, and generally the contract system is worked as follows:

The rock drill fitter is given a certain price for keeping the machine drills in good condition. The price he is given is for 52 rock drill machine shifts, and at the end of each month the contractor, or rock drill fitter, has on the credit side of his balance-sheet a certain sum which represents the total number of rock drill machine shifts returned by the mine multiplied by the contract price. On the debit side of his balance-sheet is shown the cost of spare parts, labor, etc. The contractor can make what arrangements he likes for the repair of the drills. From the amount left by deducting the debit side from the credit side the guaranteed wage paid to the contractor is taken and of the balance so obtained one-half is taken by the mine and the other half by the contractor. In this way the mine shares with the contractor any savings which may accrue through increased skill in workmanship and care as to waste, etc., and if the price is properly fixed to start with, which, of course, is the essence of the contract system, the contractor can go ahead with his work without fear of having his price cut.

There is a clause in the contract which calls for the drills to be brought up from underground after each one has worked for 156 shifts, and when the drills are taken to the shops they have to be very carefully overhauled and put into first class working order to practically correspond with a new drill.

It is laid down in the contract that the pistons have to be ground and the cylinders have to be reamed, and standard reamers have been supplied for all various sizes to which a cylinder can be bored, usually in steps of 1/32 in. diameter. It will thus be seen that by starting with small cylinders and large pistons, as the large pistons are ground down so the small cylinders are reamed to increased diameters in steps of 1/32 in., and there are always standard pistons to fit standard cylinders.

In the past probably one has looked upon the rock drill as a piece of mechanism which, so long as it will drill, need not be worried very much about, but when the cost of air and the drilling speed are taken into consideration, it can be proved that it is a commercial proposition to pay as much attention to the upkeep of drills as the upkeep of winding engines or compressors.

A COMPRESSED AIR PUMPING FEAT

A duplex direct-acting steam pump of standard make was installed at the 200 ft. level of a certain mine to be driven by compressed air, with the exhaust pipe reaching the 100-ft. level for ventilation purposes. The air-compressor at the collar of the shaft was driven by a Pelton wheel, the supply for which was interrupted during a winter night, by the wholesale freezing of the feeding flume. The pump naturally stopped, the water began to rise in the shaft, and before long had reached the 100-ft. level, and so things remained till the following spring, when the compressor was started again; a few moments later, water issuing from the delivery pipe showed that the pump had instantly responded. This, however, was due, first to the unusual extension of the air-exhaust pipe, which is very exceptional in a pump of that kind, and also to the fact that the rapid inrush of water at the time of stopping had caused the attendant to take a bee line toward upper quarters, leaving the throttle at the pump wide open.—*A. E. Chodzko.*

WATER DIVINING

The hazel twig water-finding business has recently been formally investigated at Guildford, England, and also in France and Germany. In all cases the results have been the same. Sometimes water has been predicted where water was not; sometimes sources of water have been passed over unnoticed; and sometimes water has been found by one and not recognised by others traversing the same spot. The Committee appointed to conduct the trials at Guildford reported that "whatever sensitiveness to underground water may exist in certain persons, of which some evidence has been given, it is not sufficiently definite and trustworthy to be of much practical value. Moreover, the lack of agreement with each other shows that it is more a matter of personal mentality than any direct influence of the water."

ALTITUDE AND FATIGUE

An interesting communication has been presented to the Académie des Sciences by M. Vallot and M. Bayeux concerning the relations of muscular exercise to altitude. They made use of a squirrel confined in a rotary cage, and were able to determine that the animal at the sea level made 6700 turns of the wheel a day. After this fact had been established by repeated observations, the animal was taken in his cage to the summit of Mont Blanc, at which altitude it made only 900 turns a day. When brought down to the plain it made 5000. This experiment clearly shows that the fatigue felt on muscular work by Alpinists is not solely due to the exertions of climbing, even though they take a considerable part in it. As a matter of fact, the person or animal transported without fatigue to the summit finds himself in a medium in which the rarefaction of the atmospheric pressure and the diminution of oxygen are sufficient to diminish muscular energy.

WINTER TUNNELING IN ALASKA

580 feet of 8 x 10 tunnel in hard rock, muck extracted 8300 feet from breast to dump and all piping, track and wiring laid and ready for practical use.

This is the record of "Chief" Paddy O'Neil at the big Sheep Creek tunnel for December, in spite of twenty-four hours off on Christmas day for every man of the shifts. Just a word about that "chief" part. Down at the portal camp where the big Irish tunnel foreman is a czar they all call him "Chief." For eighteen months O'Neil has been living on powder fumes. For that period of time he has eaten and slept tunnel, driving a small army of well organized machine men, muckers, and pipe men into the breast crying "record, record." The big Irishman has one ambition in life: "Break the world's record," and it might—always a chance for a slip in the tunnel game—be done in the month of January, 1914. All depends on the break of the ground and luck—because the crew and machinery is there to do it with.

PADDY IN FULL CHARGE.

"The company gives me the tools, quarters and everything I want and the crew are the best on earth," declared the chief to a *Dispatch* man Sunday. It was in the breast of the big tunnel, thirteen shots in the upper round and ten in the lower round, had just torn out four more feet of tunnel. Five minutes after Paddy had counted the shots, the head mucker was into the breast, the head man on the upper drills and the big cross bar on the waste dump ready to slide into position, and three machine men were dragging their machines to the breast. Ten minutes more and the two machines on the upper bar were chugging away, and fifteen minutes later the muckers had cleared away and the lower bar was up and the two drills on that bar were hammering the steel. Some work, believe me, boys. But that was not all, the pipe crew had laid their pipe, the electrician was already stringing his wires, and the flooring and rail crew were at it. At one time sixteen men were working with a space allowance of one square foot to the man. There was no crowding, cursing or quarreling. Every man, including the chief, who is there at every round of holes and most of the time between, knew his duty, like a well drilled gun-crew on a man of war.

THE MEN ON SHIFT.

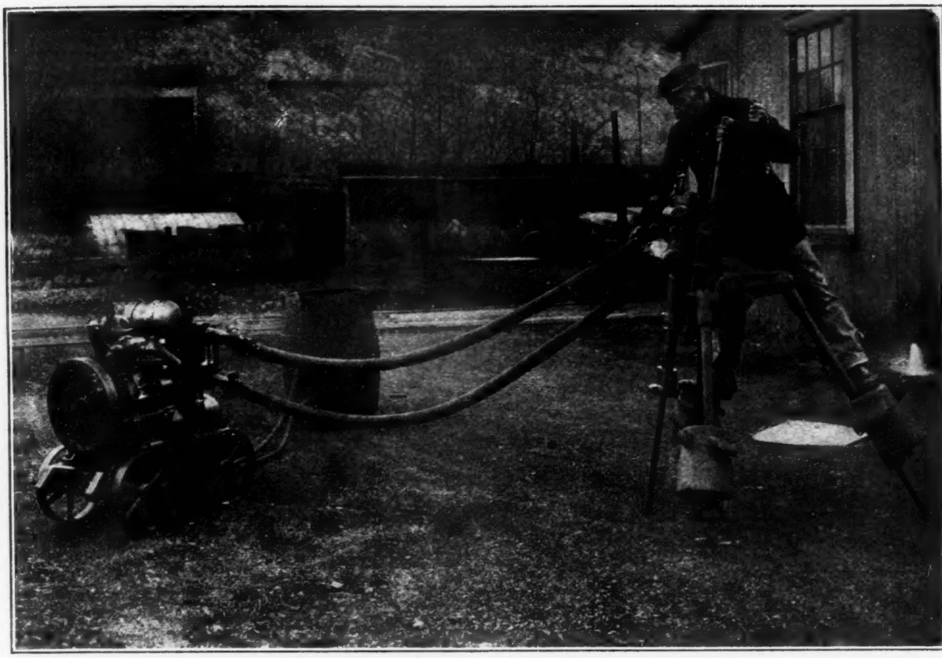
Eight machine men are on a shift, two to the drill, six picked muckers handle the waste dirt and four pipe men belong in each shift. Each shift works six hours and rests twelve. All receive more in bonus than received on straight pay, the machine men averaging close to $10 a day, while the muckers and pipe men run from $7 to $8 a day. But a man has to work, that is to hold his end up.

LOST HIS BONUS.

They tell the story at Sheep Creek of the machine man who lost his bonus. He came to Juneau three months ago and got drunk, overstayed leave, and when he returned the chief said no bonus. Right into the breast he went, and for three months worked without a bonus. To-day he is on the bonus list again, his little jamboree costing him just about $450.

FINISH IN NINETY DAYS.

It is expected at portal camp that the tunnel will be finished in ninety days, and then the husky drillers will get tame and uninteresting work like cutting out stations and sinking shafts, near child's play after the game they have been in for eighteen months. Just what will become of Paddy O'Neil is the question—many portal camp terriers declaring he will become a motion picture actor.—*Alaska Dispatch.*



GASOLINE ACTUATED PULSATOR ROCK DRILL.

A NEW ROCK DRILL OPERATED BY GASOLINE ENGINE

The "Temple-Ingersoll Gasoline-Air" rock drill has been placed upon the American market during the past month by the Ingersoll-Rand Company, 11 Broadway, New York. At present it is made in only one size, and the equipment employs the same type of drill and pulsator as are used with the "Temple-Ingersoll Electric-Air" drilling unit. The electrical equipment of the latter type, however, is replaced by a six horse power, single cylinder, gasoline engine. The gasoline motor, supply tank and pulsator are all mounted on a four-wheeled truck for easy transportation.

It is apparent at once that the "Temple-Ingersoll Gasoline-Air" drill possesses the advantages peculiar to the "Electric-Air" drill, but is also particularly suitable for use in locations where electric power cannot be economically or advantageously applied.

The gasoline engine is of the jump spark type, the ignition spark being obtained from dry cells. The circulating water is obtained from any convenient receptacle placed near the equipment. The splash system of lubrication is employed for the piston and crank pin bearing, and grease cups lubricate the main bearings. A gasoline supply tank of 1¼ gallons capacity, surmounts the engine. The fuel consumption of the engine, running under load, is about two quarts of gasoline per hour, so that the average daily fuel consumption would be approximately three or four gallons.

The drill proper of the "Gasoline-Air" unit is driven by pulsations of compressed air created by a pulsator actuated by the gasoline motor. Gearing transmits the power from motor to pulsator. The air is never exhausted, but is simply used over and over again, playing back and forth in a closed circuit. The pulsator is a simple machine, employing no water jackets.

The drill is the simplest type possible—a cylinder containing a moving piston and rotation device, with no valves, chest, buffers, springs or side rods. The cylinder is larger but the piston portion is shorter, making the weight of the drill unit about the same as, or even less, than that of the corresponding air drill.

Two short lengths of hose connect pulsator and drill, each hose acting alternately as supply and exhaust.

Some leakage of air from the system is inevitable. This is provided for by a compensating valve on the pulsator, which is adjusted to automatically maintain the requisite pressure in the circuit.

The ordinary air or steam driven rock drill takes a full cylinder of air or steam at full pressure each stroke, and discharges it to atmosphere at practically full pressure. No advantage, therefore, is taken of the expansive properties of the air or steam, and as a result an amount of power is wasted without doing useful work.

The "Gasoline-Air" drill operates on an entirely different principle. The closed system is filled with air under a low pressure, which is simply an agent for transmitting the effort of the pulsator piston to the drill piston. The air in the system has been aptly referred to as a pneumatic "spring," unwearing and unbreakable, exerting its pressure on opposite sides of the drill piston and the pressure in the air is analogous to the tension of a spring. That the saving in power is great is proven by the fact that, under ordinary conditions, the drill proper of the "Gasoline-Air" unit uses about one-fourth the horse power required for the usual air or steam drill, of the same work capacity.

The "Gasoline-Air" drill has a stroke equal to, or even greater than that of the air driven rock drill of corresponding capacity. The length of stroke is varied simply by cranking forward in the shell, and both stroke and force of blow may be adjusted by the same means for fast drilling under any circumstances. If a hole should "mud up" or form a "mud collar" in bad rock, the machine can be backed out without injury while running, thus clearing itself quickly. The cushioning is such that the piston, in running, does not normally strike either front or back head. This makes very easy the problem of handling it in all kinds of drilling.

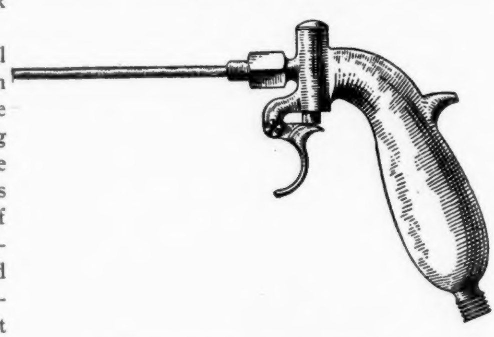
When the ordinary rock drill, whether steam or air driven, sticks or fitchers it simply pulls back with a steady pressure and the steel must be sledged until it loosens. The "Gasoline-Air" drill, on the contrary, when it does momentarily stick, receives on its piston upwards of 400 alternating pulls and pushes per minute; and this repeated pulsation has a tendency to promptly loosen and dislodge the stuck bit.

The system of lubrication of the pulsator is automatic and complete, the "splash" method being employed. While most of the oil drains back to the crank chamber, a portion is atomized and carried through with the air into the drill.

The drill cylinder diameter is 4¾ inches and the stroke is 7 inches. The drill will accommodate octagon steels from 1 to 1⅛ inches in diameter, drilling holes from 1¼ to 2 inches in diameter. The drill feed is 24 inches. The approximate strokes per minute are 440. The machine is designed to drill holes up to about 12 feet in depth.

Economical in power consumption, rugged in construction, easy to understand and operate, efficient in its working, this drill appeals particularly to the small operator, because of the lower installation cost, no compressor or boiler plant being required.

Its field covers quarrying and contracting operations, particularly those in isolated locations where the high cost of coal forms a serious handicap in many cases. Its advantages for winter operations in quarries will also be apparent to those who have experienced trouble from the freezing tendencies of ordinary drills.



PNEUMATIC CLEANING GUN

The cut shows a device about which there is practically nothing to say, as everything about it is so simple and self-evident. A small air hose is connected to the butt of the handle, the nozzle is placed wherever there is any dust or loose material, and then a touch of the trigger does the rest. A long and a short jet pipe of flexible copper is furnished with each gun and these can be bent by hand for reaching places not easily got at. The device is made by the G. H. Dyer Co., 39 Piedmont street, Boston.

AIR COMPRESSORS VERSUS HYDRAULIC PUMPS IN WOOD PRESERVATION

BY F. J. ANGIER*

It is the practice at most timber-treating plants to use hydraulic pumps to force the preservatives into the wood. This is a practical and efficient way of performing that service, and while the hydraulic pumps may have some advantages over the use of compressed air, they also have some disadvantages. When designing the B. & O. plant at Green Spring, W. Va., this feature was given careful consideration, and it was finaly decided to use the air pump. The idea of employing compressed air for forcing the preservative solution into the wood to be treated was, so far as is known to the writer, first adopted by the C. & N. W. at its plant at Escanaba, Mich. Here the apparatus is different from that used by the B. & O., but the principle is practically the same.

In the application of the air-pressure system at the Green Spring plant, there are employed two small upright tanks, called "pressure-measuring-drain" tanks, deriving their descriptive title from their three distinct operations —for pressure, measuring, and drain. In the case of the ordinary pump method, at least two tanks would be required, one for pressure and measuring, and one for drain.

COMPRESSOR ADVANTAGES.

The advantages of the air pump are: Only one tank is required for each retort, that tank serving in the triple capacity of pressure tank, measuring tank, and drain tank; one air pump is ample for three retorts, while one hydraulic pump is required for each retort; the maintenance of one air pump is much less than three hydraulic pumps, and is decidedly cleaner. The air pump requires less attention, and lessens the cost of packing, lubricants, valves, valve seats, plungers, etc.

An air pump is a necessity in plants using hydraulic pumps for blowing back solution, unless those plants are equipped with expensive underground receiving tanks. In the latter case an air pump can be dispensed with in lieu of a large oil pump for pumping solution back into the working tank. The underground receiving tank is more expensive in operation than the air pump, and no doubt this is the reason why so few plants are thus equipped. One air pump can be operated on two or more retorts at the same time without deranging the gage readings. This is not practicable with hydraulic pumps. Experience has taught us that it is practically impossible to maintain a steady and constant pressure on a charge of timber with a hydraulic pump, even though it is equipped with relief valves, while with the air pump this is easily accomplished.

The amount of steam required to operate one air pump is not more than would be required to operate three hydraulic pumps, but as the exhaust steam is used for heating purposes, this feature is not so important.

TABLE 1—COST OF AIR-PUMP SYSTEM

1 air pump (capacity 8 cu. ft. of compressed air per minute at 175 lb. gage pressure)	$1,200
3 pressure-measuring-drain tanks	2,000
Piping, valves, etc. (estimated)	400
Total cost of air-pump system	$3,600

TABLE 2—COST OF HYDRAULIC-PUMP SYSTEM

3 hydraulic pumps	$1,000
3 measuring tanks	900
2 drain tanks	400
1 low-pressure air pump	500
Piping, valves, etc. (estimated)	600
Total cost of hydraulic system	$3,400

The initial cost of installing the air pump system is, according to the accompanying table, a trifle more than for the hydraulic pump system, but the maintenance is less, and in the long run air is more economical.

With hydraulic pumps there is more machinery to care for, more tanks to look after, and more piping and valves to maintain. There is also more work for the engineer, and unless everything is compactly arranged the the engineer will require an assistant. With the air pump one man can easily look after the entire operation with greater satisfaction and with better results.

[It is proper to remark that in the above table the cost of the air pump or compressor of the given capacity is much too high, and if that item alone was corrected it would no longer appear that the cost for air was higher than for the hydraulic equipment. Ed. C. A. M.].

*Supt. Timber Preservation B. & O. R. R. Abstract only of paper.

While working on the new survey over the Siskiyous, a gang of men under Assistant State Highway Engineer Kittridge of California struck a three-foot gold ledge which mining men declare to be of a high grade.

LOW PRESSURE COMPOUND AIR LIFTS

BY A. E. CHODZKO.

Whatever be the exact behavior of compressed air in raising water up a delivery pipe, it will have yielded all of its useful effect if, in course of the process, it expands from its initial to its final, that is, to atmospheric pressure. Now, if (P_1) is the absolute air pressure (that is, the gauge pressure plus atmospheric) and (P_0) the atmospheric, it is easily found that at any particular place, if the compressed air enters the pump at the same temperature as it entered the compressor, the efficiency (E)—that is, the ratio of the work done by the expansion of the compressed air to the work absorbed in compressing it—is expressed by

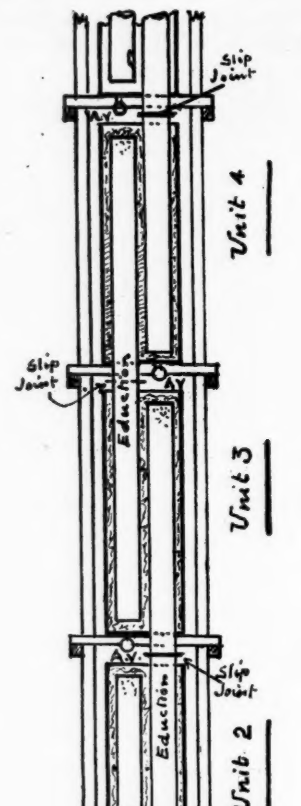
$$E = M \left(\frac{P_0}{P_1}\right)^{0.29}$$

when (M) is a numerical factor involving the altitude, and the mechanical efficiencies of compressor and pump.

The conclusion is that a low-pressure air plant is more efficient than a high-pressure one, or, in this particular case, that a low lift is more efficient than a high lift. And, therefore, if water is to be raised to a great height, the idea naturally occurs of cutting this up into a number of shorter divisions, each supplying water to the next one above. This has been suggested as a means of adapting the air-lift to mining work, each division being made longer than the one below, and a great height could thus be reached with a limited number of successive steps, the air pressure increasing from one to another.

A more satisfactory result is obtained by making the subdivisions of equal lengths. The pump column is then formed of a series of equal sections, or units, placed end to end, the air main running alongside of them, and a numerical illustration will give a clear idea of that arrangement and of its results. It will only be mentioned at this time that all the elements of an air-lift of that type can be determined with the same degree of accuracy as the details of an elaborate plunger or centrifugal pump. The figures here given are purposely approximate.

We will assume that 2000 gal. of water is to be raised per minute to a vertical height of 1424 ft. Were we to pump water against 1424-ft. head the pressure per square inch at



LOW PRESSURE COMPOUND AIR LIFT.

the foot of the delivery pipe would be about 640 lb.; a displacer would have to use compressed air at that pressure and even somewhat higher. The total lift of 1424 ft. will be divided into 100 equal units. Each unit, see sketch, consists of a tank, open at its upper end, and which may be of rectangular cross-section. A vertical eduction pipe is suspended in that tank with its open lower end a few inches above the bottom. Directly under it is the compressed-air nozzle, connected by a branch pipe to the air main. The lower unit is connected with the water-supply, which maintains into it a depth of 11.1 ft. The eduction pipe passes through the bottom of the second unit, and has its open upper end 11.1 ft. above that bottom; it is therefore a plain straight pipe open at both ends. The same arrangement is repeated in each unit; that is, each has a separate air jet and an eduction pipe rising to the top of the next. Each unit therefore consists of a rectangular tank, open at the top, and containing two parallel eduction pipes, one for its supply, the other for the discharge.

This being understood, the pump is ready to start, and air is turned on in the lower unit. As the head of water is 11.1 ft., a pressure of 5 lb. per square inch is sufficient. The emulsion of air and water rises up the eduction pipe and overflows into the second tank; the air, completely expanded, escapes in the shaft, while the water fills the space in the second tank not occupied by the eduction pipes. This water is picked up by air jet No. 2 and sent into the third unit, and so on, the same process being repeated through all the successive units to the top. An initial submergence of 11.1 ft. and an air pressure of 5 lb. gauge are all the requisites of the total lift; in the same locality, and with the same type of outfit, they would answer equally well for any other value of that lift.

Especial attention is called to the following points:

1. Since the units are all of equal length, this "low-pressure" arrangement consists in splitting up the entire lift into a series of shorter ones with a theoretic submergence of 50 per cent., the total efficiency being obviously the same as in each independent unit, regardless of their number. Whatever the total lift is, the submergence need not be more than the depth of the water in the first unit of the series.

2. The low air-pressure can readily be obtained from centrifugal blowers; this means a great reduction in first cost and maintenance of air-compressing outfit.

3. Whatever be the total lift in the same locality, at no portion of it are the air or water pipes to resist more than 5 lb. pressure to the square inch. Wood stave pipes or rectangular ducts are therefore quite acceptable, so that the pump can be built on the spot and kept in repair with local resources.

4. Each eduction pipe is cut off between two successive units, and a slip joint is used for connection. Any unit can therefore be detached from or attached to the line without disturbing the rest. These units, being identical, may be kept in readiness; any one of them may be placed at any point along the line.

5. In any specific case, the unit intended to form the pump column (and which is quite comparable to a link in a chain) is designed to perform a certain duty; that is, to raise a certain volume of water, at a certain altitude and mean temperature, and with a certain air-pressure. The volumetric ratio of free air to water is thus determined, and such a unit will fit a 60-ft. lift or a 6000-ft. lift equally well, be it in a mine shaft or in crossing a range of mountains. A change in one of the above elements in the design of the unit influences the others to an extent that can be determined. The simplicity and cheapness of construction make alterations in shape easily practicable.

6. At starting time, all the units are empty except the lower one, and each one is connected to the air main, so that, when air is turned on, it would blow off and be wasted all along the line. It is therefore necessary to provide each unit with an air valve automatically closed and thrown open when water reaches the submergence level in that unit. These valves are all identical and interchangeable, they are of simple design, entirely automatic, and they can be removed and replaced in a moment.

7. The pump requires no foundation, being suspended by cables during the unwatering period, and each unit is supported by the shaft timbers when stationary. The details of

its handling deserve and have received special attention.

8. At an assumed altitude of 4650 ft., each unit in the case at hand consumes 500 cu. ft. of free air per minute, making the capacity of the air-compressing plant 50,000 cu. ft. per minute, a figure by no means abnormal with centrifugal blowers. Here appears a unique feature of this type of pump, inasmuch as these 50,000 cu. ft. of air are discharged every minute into the shaft, where they create a powerful draft; this can readily be utilized for ventilation, either by suction up the shaft or by establishing a down draft, and this duty is performed at no additional expense. This twofold service of the air for drainage and ventilation, with the motive power placed in safety, introduces in the equipment of a mine a unique and additional element of economy. The pump will, of course, operate under water, in spite of the low air-pressure, because the first "active" unit is always the one nearest the surface, those below it (as they might be in case of sudden flooding of the shaft) are "dead" and inoperative, so that the work of the air-compressors is always measured by the actual lift.

These remarks, it is hoped, may suffice to draw attention to a system of mine pumping which escapes most of the objections mentioned against the familiar types of station plants. It does not involve any but simple, well known, and tried principles of action, and yet, it presents some practical and economical advantages of its own. It is not claimed, nor is it true, that the low-pressure lift should in all cases supersede any other types of pump; it has been worked out, and it is specifically intended for high lifts and large volumes of water; and when unwatering and draining a deep mine, it can accomplish some work which a pump of the usual design cannot do economically. It is very much cheaper in first cost than its equivalent in capacity, and it can be repaired with local resources and labor without resorting to a well equipped and too often distant machine-shop.—*Mining and Scientific Press.*

HOW TO LIGHT A FUSE

"The easiest thing in the world," you say, "just strike a match, hold it to the end of the fuse, and light it. That's all there is to it." But it isn't. Like many other simple operations, there are many ways of performing it, and it fills an experienced blaster with amusement to see a beginner use up about a box of matches trying to light one fuse. One way, about the slowest and most uncertain, is to strike a match and hold it so that the flame comes in contact with the end of the fuse. Theoretically, the powder in the fuse should light at once as soon as the flame strike it, but practically and actually it generally doesn't until the hemp, cotton or jute composing the wrappings of the powder core catch fire and the glowing threads ignite the powder. It is almost impossible to hold a match flame under a piece of fuse in the open air as the slightest breath of wind will blow it out.

Another way, says the Dupont Magazine, is to split the end of the fuse lengthwise, open up the powder core exposing the powder, and put the flaming match into the powder. This is all right, providing you have a sharp knife, a good eye and a steady nerve, but unless you have all these you will either cut your finger, or in your hurry to light up and "light out," you will shake the loose powder out, so that the fuse won't light.

The proper way to light a split end fuse is to place the end on a stone, block, or some other dry, solid object, and slit it through the powder core but no further. Open up the end and apply a match, or better still, the glowing end of a "punk" stick, such as the children use on the Fourth of July, or a dry cotton window cord, directly on the exposed powder. This latter method is about the best way when a large number of shots are to be fired as in block hole or mudcap shooting in quarries or railroad work.

About the best way to light one fuse with a match is to cut off the exposed end to get a dry, clean portion of the powder core exposed, and take a box of safety matches and hold the fuse and the match box in the left hand in such a way that the end of the fuse lies alongside the composition of the match box and on the same plane. Now, strike the match on the composition and instantly, before the head of the match gets fairly ablaze, put the match head directly on the center of the fuse. If the match head is not too small (the larger it is the better), it will infallibly light the fuse. This takes a little practice, but it is worth it to be able to quickly and safety light the fuse every time, and being able to do it with neatness and dispatch shows that you understand your business.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Established 1896

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CONTENTS

COMPRESSED AIR STORAGE IN ROCK

On another page of our present issue is given an interesting account of the utilization of an abandoned mine drift for service as a compressed air receiver. This is by no means a novelty as we have more than once previously described such an achievement. It is rather to be wondered at that there are not more of these rock air receivers. In many, if not in most mines there must be similar abandoned drifts or sections of tunnel which might be appropriated. In mines where air is likely to be used for a considerable time in the future it might even be worth while to excavate a special cavity in new rock for air receiver service. With concrete and the applications of it as at present developed, and with suitable water proof—which should be also air proof—paints for the interior there should be no difficulty about making a receiver almost absolutely airtight.

The rock receiver now described has a capacity probably equal to that of twenty steel receivers of familiar size, and the ability to store compressed air in such volume must be a satisfaction to a mine engineer. According to the description given, however, the receiver has the one general objection that it will not maintain a constant full pressure, but will allow an instant and continuous drop when the air consumption exceeds the compressor output, which puts all the air operated tools and machinery at an immediate disadvantage, with actual stoppage imminent. No matter how large the capacity of an air receiver it fails in its most important function if it does not maintain a constant pressure as long as it is operative at all.

Our columns have already called attention to the device which makes this easily possible. The arrangement is extremely simple, it is self-evidently practicable without the necessity for any experimenting, and it has been magnificently demonstrated at the Anaconda Copper mines, as we have previously recorded.

In connection with the rock receiver now spoken of, if there had been in the neighborhood another cavity in the rock, or any open receptacle, for a body of water sufficient to entirely fill the receiver, at an elevation of say 200 ft. above it, it then would have been only necessary to connect this water supply with the bottom of the air receiver by a pipe which would permit an unobstructed flow of

the water back and forth. Then if the air pipes, both inlet and discharge, were connected with the top of the receiver the arrangement would be complete. The pressure of the air would be constantly maintained above 85 lb. gage, by the pressure of the water until all the air was used out of the receiver. If the compressor was delivering more air than was being used the water would be driven back up into its tank but the air pressure would be maintained. It should not be necessary to remind our readers that the contact of the air with the water in this way would not add to the vapor content of the air, a fact which has been presented in our pages in various forms.

SURVIVAL OF THE FITTEST IN ROCK DRILL PRACTICE

The following is a brief extract from a valuable article by H. A. Guess entitled, "Mining in Southeastern Missouri Lead District," in the Transactions of the American Institute of Mining Engineers:

Less than 5 per cent. of the drills of the district are now run with two men, and it is probable that within another year nothing but one man drills will be in use. The type first adopted by those companies was the Sullivan U. S. 2.25 in. Within the past year, however, faster cutting drills than even the 2.25-in. Sullivan have been sought, and as a result one company has adopted water Leyners throughout, while two other companies are using the Ingersoll C-110 2.75-in. Butterfly-valve drill for a large part of their work. Attention has also been given of late to the large amount of time consumed particularly in tripod work in setting up, even with the one-man drill, and several of the companies are therefore beginning now to use hammer drills of the self-rotating type for down holes and even for lifters. These hammer drills for holes of not over 8-ft. depth will drill fully as fast as piston drills and no time is consumed in setting up, while the air consumption is only about one-half that of a 2.75-in. piston drill.

Steel is 1-in. octagon, solid, except for the Leyners, while for the hammer drills 7/8-in. hollow steel is used. The sets are of 2-ft. range from 2 to 12 ft. for piston drills and 2 to 10 ft. for hammer drills. Machine sharpening is quite general throughout the district, using either the "Z" bit or the + bit, and for the hammers a 6-star bit.

Consumption of air and of powder has been lessened by the contract system, as more skill is used in placing holes and therefore more tonnage is broken per linear foot of hole. Approximately 29 ft. of holes are drilled per shift per single machine, and approximately 1 ton is broken per foot of hole.

Power costs, as compressed air for drilling, are approximately 5 cts. per ton, and explosives 8 cts. Air is distributed to the drills at about 80-lb. pressure.

GAS ENGINE DRIVES

The Federal Glass Company, Columbus, Ohio, have recently bought from The C. & G. Cooper Company, Mt. Vernon, Ohio, a heavy duty Gas Engine Driven Air Compressing Unit. The Engine is of the Horizontal Single Tandem Double-acting type, having cylinders 19 inch bore, 24 inch stroke, and rated at 310 brake horse power. The Air Cylinder, which is of the Ingersoll-Rand Company's make, Hurricane inlet valve type, is direct coupled to the Engine on the front end of the Bed Plate. It is 26¼ inch diameter, with a capacity of 2100 cubic feet of free air per minute at 140 revolutions. This installation is a notable one, in that it marks a preference for the direct-coupled type of Gas Engine and Air Compressor, over the belted types, for highest efficiency, economy, and reliability of operation. The Cooper Company has also sold to The Charles Boldt Company, Cincinnati, for their new Huntington, W. Va., plant, two 550 brake horse power Gas Engines, each to be direct connected to a 350 K. W. Generator.

It becomes a matter for permanent record that on January 7, 1914, the Alexander La Valley, passed through the Panama Canal from the Atlantic to the Pacific under her own steam.

Of ninety thousand gas meters tested by the Inland Revenue department in different parts of Canada during the last year, 881 were found to be defective, and were rejected and condemned. Of this number, 235 were running slow, while 521 were running fast. It was found that 19,970 were a little fast, but 49,520 were a trifle slow, saving money for the consumer.

COMPRESSED AIR STARTERS

BY A. L. BRENNAN, JR.

During the experimental stages of self-starters, compressed air was used extensively and proved entirely reliable; but designers soon found that along practical lines it was adapted only to heavy power units. This was principally because on motor cars and boats the space available is often limited and since the first requirement of a mechanical or functional self-starter is compactness, this condition could not always be had when using a system that is not self-contained.

The component parts of a compressed-air system consist of a valve mechanism or distributor for controlling the air to the cylinders, suitable piping, air compressor, and storage tank for air. A tank holding air sufficient to start even a small multicylinder motor several times without recharging must be of fair size and consequently takes up considerable room. Some argue that a tank holding sufficient air to start the motor once is sufficient. This is poor practice, for, unless the tank is of sufficient volume to start the motor several times without recharging, any one of the several complications liable to take place when starting will render the self-starter inoperative. Little difficulty is encountered when installing this type of self-starter in stationary plants for the room required for suitable storage tanks is usually a secondary consideration.

The first cost of a compressed-air system is usually low and the operating and maintenance cost is small; also it requires little attention. In regard to the correct installation of such a system the following suggestion will be found of value.

Instead of using one large tank for the storage of the compressed air, two tanks should be used, one large and one small, fitted with suitable piping and valves to regulate the admission and release of air from either or both tanks. This will allow the compressor to feed air to either or both tanks and the small tank can be held for emergency purposes. A hand pump should be connected to the small tank, thus affording an auxiliary pumping system. If the joints are made up well with shellac and suitable valves are placed at the tanks, the air pressure should remain almost indefinitely.

Some air-starting mechanisms are controlled by a distributor which operates on the same principle as a timer which governs the flow of electricity to a spark plug. This method has proved entirely satisfactory and is to be found on several motors of various sizes. On other engines the direct-valve system is employed, the valves being controlled by a shaft which, when shifted, engages with the inlet compressed-air valve stems and causes the valve to open and admit compressed air to the cylinder last under compression, thus forcing the piston down, since both intake and exhaust valves are closed. The air valve is closed when the piston reaches the bottom center of the stroke and a similar set of operations take place in the next cylinder in the order of firing. The same operations take place in connection with a distributor starter, the only difference being that the air is admitted by the distributor "uncovering" instead of a valve opening.

Since both inlet and exhaust valves are closed during the admission of the compressed air, the efficiency of the mixture is not impaired for the reason that the air is not admitted to the cylinders until the pistons have passed the point of firing. The "direct valve" method appears to hold favor on large motors, although it must not be conceded from this that the disk distributing valve is not dependable.

The chief difficulty encountered with automatic air-starters is attributable to loss of pressure which in turn can be traced to poor check valves, faulty joints in the pipe line, distributor or valves leaking, worn or scored compressor cylinders, or the compressor piston or rings worn or broken.

AIR LEAKS.

Air leaks are usually easy to trace if undertaken in a systematic way. The writer has found an old shaving brush and a piece of shaving soap convenient for locating leaks of this nature. By painting the joints of the pipe line and other parts likely to leak with soap suds, a leak is easily detected and in fact very slight leaks can be found in this way which would otherwise go unnoticed. Care should be exercised when making up joints that the pipe fittings take hold for at least four or five threads. Shellac is undoubtedly the best medium to use for all air-line joints and

should be applied evenly to both sets of threads and the joint set up firmly at once. Joints so treated will stand vibration without leaking.

Grinding is about the only positive remedy for a leaking valve. Valve grinding may be considered an art in itself, but the novice can get good results by following a few simple rules: Never attempt to grind a valve without first removing its "seating"spring for otherwise both the valve face and its seat are likely to be deeply scored. Never grind a valve by revolving it one way, but alternate, revolving the valve two or three times in one direction and then two or three times in the opposite direction. When changing the direction of rotation, lift the valve from its seat, turn a quarter and again seat, this will cause other particles of the abrasive to cut and prevent scoring or cutting in one place. Never use a dry abrasive except the very fine powders for finishing. Grinding is greatly facilitated by playing a spring under the valve head that will cause the valve to leave its seat when relieved of the pressure exerted when grinding. The valve should be ground against its seat until both have a bright even surface which will insure an air-tight union.

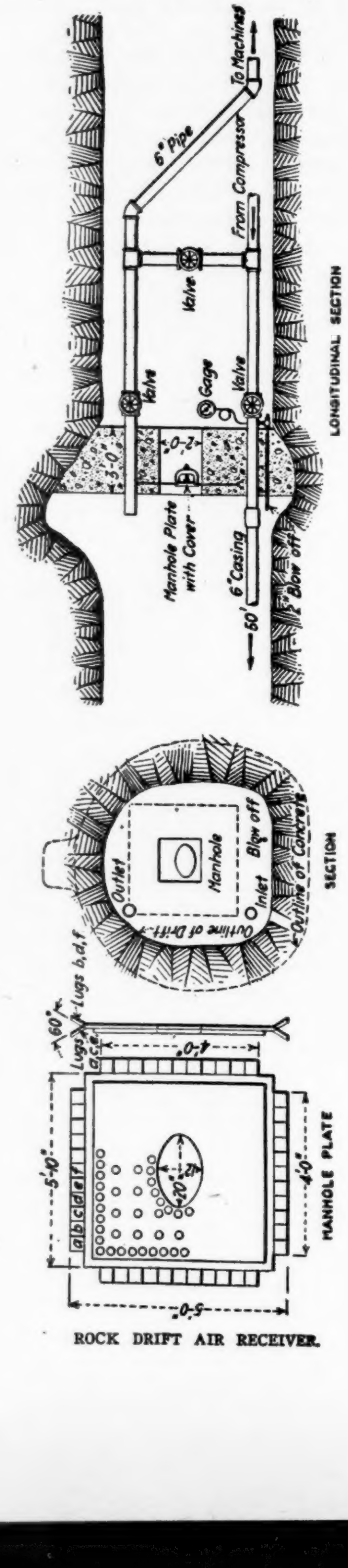
Starting troubles which prevent a gas engine from picking up its cycle when hand cranking is employed will likewise result in a non-start of motors fitted with self-cranking devices, therefore, if a motor is turned over by an auxiliary means and does not start within thirty seconds, this is, usually, a positive indication of existing trouble.—*Power.*

ROCK DRIFT FOR AIR RECEIVER

BY L. D. DAVENPORT.*

Compressed air for the hoist and the machine drills at the Ernestine mine, Mogollon, N. M., is furnished by two Ingersoll-Rand machines. The air is conveyed from the compressors at the power plant, across the canon and into the mine to the receiver by a 6-in. pipe line.

The air receiver was formed by placing a concrete bulkhead 3 ft. in thickness in an unusual crosscut in the brown andesite foot wall. This was built against a beveled recess cut in the rock. The crosscut thus bulkheaded is 109 ft. long and has an average cross-section of 42.7 sq. ft., giving a storage capacity



ROCK DRIFT AIR RECEIVER.

*Engineer, Oliver Iron Mining Co., Eveleth, Minn.

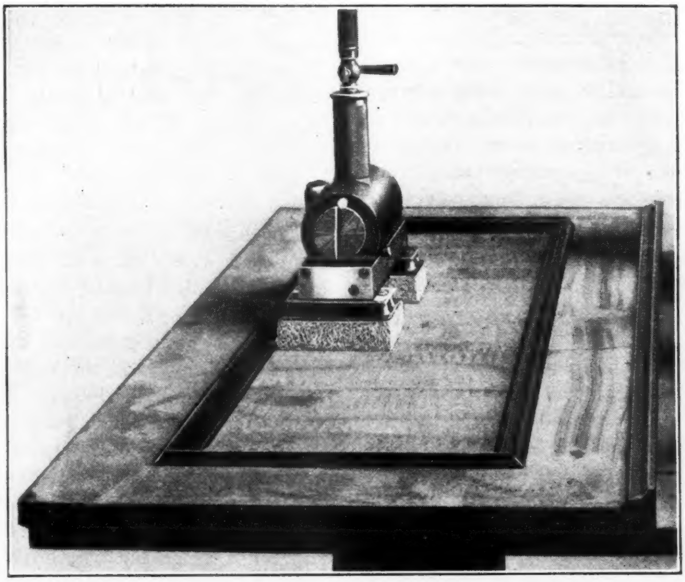
of 4654 cu. ft. A manhole plate, fitted with a cover, was set in the concrete 6 in. from the inside face of the bulkhead as shown.

The 6-in. line from the compressors passes through the bulkhead near the bottom of the crosscut and 6-in. casing pipe extends this line about 50 ft. beyond the bulkhead inside the receiver. Air is taken out near the top of the crosscut through another 6-in. line, which extends just through the bulkhead.

A cross-connection and the necessary valves were provided so that the receiver may be cut out if it is desired to remove the manhole cover. A 2-in. blow-off close to the bottom of the drift allows any water collecting in the receiver to be removed.

A 1:3:5 mixture was used in the bulkhead and the structure was reinforced with old 10-in. rails, machine screws and other scrap. Sand was screened from the creek bed and packed on burros to the mine dump. The rock used was shot from the rhyolite hanging wall near the receiver. The cement, like the manhole plate, was freighted 90 miles overland from the railroad.

The manhole plate was made of two ½-in. boiler plates riveted solidly together. The larger plate is 5 ft. square and has its edges cut back to form lugs 4x4 in., as shown, which were bent out alternately in opposite directions to anchor in the concrete. The smaller plate is 4x4 ft. The opening in the concrete is 2x2 ft., so that the plate had sufficient bearing in the concrete.—*Eng. and Min. Journal.*



A PNEUMATIC FURNITURE RUBBING MACHINE

The halftone shows a pneumatic tool made by the Rockford Tool Company, Rockford, Ill., which has proved itself an immediate boon to furniture manufacturers. It is used for rubbing and polishing flat surfaces of wood, thereby relieving the worker from one of the most tedious and tiring of operations, and doing the work two or three times as fast, with a proportionate saving in cost.

The machine is air actuated, using the air at the ordinary working pressure for pneumatic tools. The rubbing blocks move back and forth lengthwise of the machine some 900 times a minute, and the rubbers are moved by hand all over the surface to be finished. Pumice or other stone with water is thrown on to the surface to be rubbed, the same as when rubbing by hand. Then the machine is slowly moved across the surface, first to and from the operator, which motion keeps the water and pumice between the felts and prevents the varnish from heating and picking up.

By putting a little pressure on the machine the first time across it will more quickly cut the surface, and after an operator has used the machine for some little time he can very quickly tell when the work is done. The finish is superior to that produced by hand rubbing, as it is much more uniform. The machine is very handy for sunken panels, and works into all square corners. The machine makes another demand for the air compressor installation which is now practically indispensable in any up to date industry.

NOTES

An interesting article by Claude T. Rice, describing the Mitchell Dust Catcher for Stope Drills, presented in our February issue, should have been credited to *Mining and Engineering World,* in which it first appeared.

The hydraulic plant situated on the Lontsch River in Switzerland is now using what is claimed to be the largest Pelton wheel in Europe, the wheel being of 15,000 horse-power. In the same station there are already six Pelton wheels of 6,500 horse-power, so that the addition of this latest wheel brings the output of the Lontsch plant up to 54,000 horsepower and makes it one of the largest plants in Switzerland.

For the most effective ventilation it is most important that the air be kept in motion. Merely changing the air is not enough. Workmen will be comfortable in a warm shop if a perceptible breeze can be felt. It is a mistake to design a shop, especially a blacksmith shop, with the window openings six or seven feet above the floor. The men below do not feel any breeze and the evaporation of perspiration is slow.

The salary of Alfred Craven, chief engineer of the Public Service Commission, First District, New York City, has been raised from $15,000 to $20,000 per annum, making his salary the highest of all the engineers in the service of New York City or the State. In the capacity of chief engineer of the commission Mr. Craven has charge of all the work of the dual subway and transit system now under construction, involving the expenditure of $167,000,000.

It is reported that construction will soon be begun of a railway bridge connecting Rugen, an island in the Baltic Sea, almost due north of Berlin with the mainland of Germany. This bridge when completed will be one of the longest, if not the longest, in the world, exceeding even that over the Hwang ho, which is 10,740 ft. long. The cost of this great engineering work is not expected to amount to much more than $5,000,000, which will be less than a third of the cost of the Forth bridge.

It is stated that the first electrical plant to relieve the Arctic darkness will be erected at the Episcopal Mission at Point Hope. It will be designed, built and equipped by Dr. W. E. Temple, head of the electrical engineering department of the University of Pennsylvania. The site on which the plant will be erected will be 100 miles north of the Arctic circle. A huge windmill will be the prime mover, as the velocity of the wind at Point Hope is said to be rarely less than twenty miles an hour, but an auxiliary petrol motor is to be installed.

A pneumatic auger for removing timber has been tried with success at the Central Mine, at Broken Hill, Australia ("Proc." Aust. I. M. E., No. 10, 1913). Under the conditions of work it becomes necessary to drive new crosscuts over the old and the removal of the old timbering has been always a source of delay and expense, especially as neither an ax nor a saw could be used to advantage. Experiment with the Ingersoll-Rand augers was successful and two are in constant use. A plugger drill with a wide chisel blade was tried with fair succecss, but was less comfortable to use.

Pneumatic methods for finding flaws in rock indicate whether or not the rock is pervious, but they do not locate the seams. An elaboration of this method is to attach rubber washers to a mouthpiece and by means of them to close off a small part of the hole and thus locate possible seams. This procedure, however, is tedious, and a method used near Augusta, Ga., for the investigation of the foundation for the dam of a hydroelectric project is claimed to be more economical. Here test holes were drilled into the granite—which

was the prevailing rock formation—and dye was forced into the holes. In subsequent core-borings the color showed where flaws existed.

There is a great difference between Mexican revolutions and South African strikes. In a Mexican revolution every effort is made to preserve the mines from injury, and only to a limited extent is the labor supply affected. In a Transvaal strike, on the contrary, every effort is made to injure the mines and to close them down. On the whole, we prefer a Mexican revolution to a Transvaal strike! If the Mexican rebels and their enemies were to act towards the mines as the Transvaal strikers desired to do on the Rand last July, and again last week, the mines might come almost under Shakespeare's definition of "the baseless fabric of a vision," for not a "wrack" would be left behind.—*Mining World, London.*

The oil business and mining often are spoken of as twin industries, but over in Scotland this really is the case. There are no wells in the Scottish field, the oil is not even fluid; it is in a shale formation. This shale is almost as black as coal, and lies at a depth of about 400 ft. below the earth's surface. The oil shale is mined just as coal is mined, the rock is crushed into small pieces in crushing works similar to coal breakers, and the crude oil is squeezed out of the small pieces of shale much as water is squeezed out of a sponge. One ton of shale yields an average of 14 gal. of oil. Scottish oil goes through four different processes of acid distillation. The oil field in Scotland lies between Glasgow and Edinburgh, known as the West Calder field, and the deposits of oil-producing shale are said to be practically inexhaustible.

A system of tunnel canals is proposed for construction between Christiania and Lake Oieren in Norway. The lake is 325 ft. above sea level and is separated from the sea by a mountain 525 ft. high. It is proposed to construct a level tunnel 9⅓ miles long from the north end of Lake Oieren to Lake Ostensjo, from which another tunnel 2 miles long would run to the Bakkelags height, whence four deep locks would lead down to the Christiania fjord. The long tunnel canal would be 30 ft. wide and 16½ ft. deep. The variations of water level in Lake Oieren, amounting to as much as 10 ft., would necessitate a regulating lock at the entrance to the main tunnel. Lake Ostensjo is 13 ft. higher than Lake Oieren and would have to be lowered accordingly. The locks at the Bakkelags heights would be 200 ft. long and 26 ft. wide, with a fall for each of 82 ft. The cost is about $5,000,000.

Work on the pioneer bore which is the preliminary step in the construction of the double-track tunnel under Rogers Pass, B. C., for the Canadian Pacific Railway has advanced 850 ft. into the mountain from the east portal. On the morning of Jan. 28 blasts were fired at the heading on this end, and at 2 p. m. workmen were sent in to resume drilling operations. They met with foul air caused by powder gases, and attempted a hasty retreat, some of the men helping others who were less able to escape. At the tunnel entrance it was found that six men were missing and a rescue party was quickly organized. Conditions within were so bad, however, that one by one five of the rescue party were carried out unconscious, and it was only by dint of heroic work, it is said, that those who were overcome were finally brought out. All but two, however, were finally revived.

The alloy Tantiron is a special grade of cast iron made in England and very high in silicon. It has special resistance to corrosion and is therefore recommended for use in pipes and fittings in chemical works and other places where acid attack is the chief consideration. It is said to be very brittle and so only suitable for small castings.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

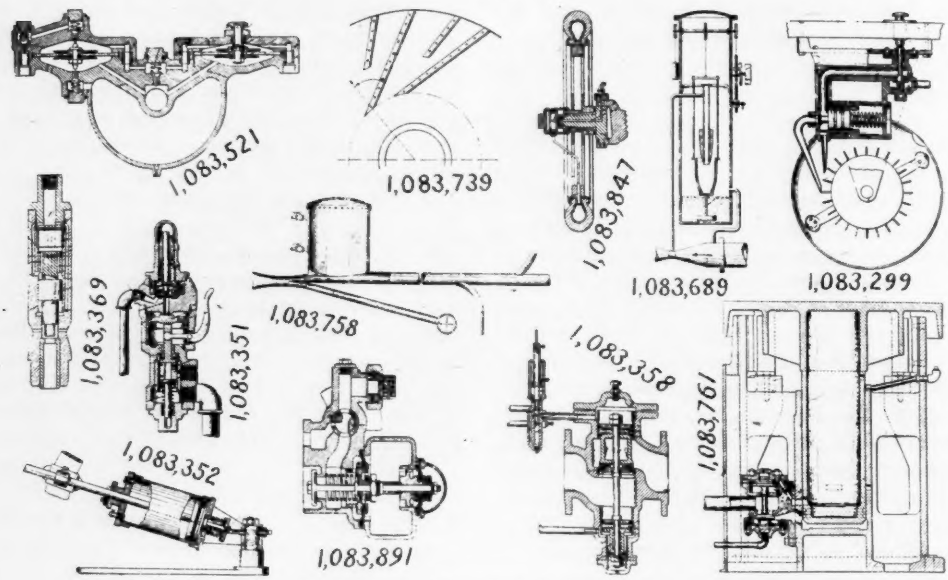
JANUARY 6.

1,083,299. FLUID-ACTUATED ALARM. George R. W. Roberts and Harry Hoopes Seely, Alameda, Cal.

1,083,351. SAFETY DEVICE FOR BRAKES. Sidney G. Down, Chicago, Ill.

1,083,352. AUTOMATIC CLUTCH-LEVER REGULATOR. William E. Eastman, Boston, Mass.

2. A clutch lever regulator comprising an oscillating cylinder; a piston therein having a piston rod attached to the lever of said regulator; a valve in the foot of said cylinder, normally closed, and means, induced by the oscillation of the cylinder, to open and close said valve



PNEUMATIC PATENTS JANUARY 6.

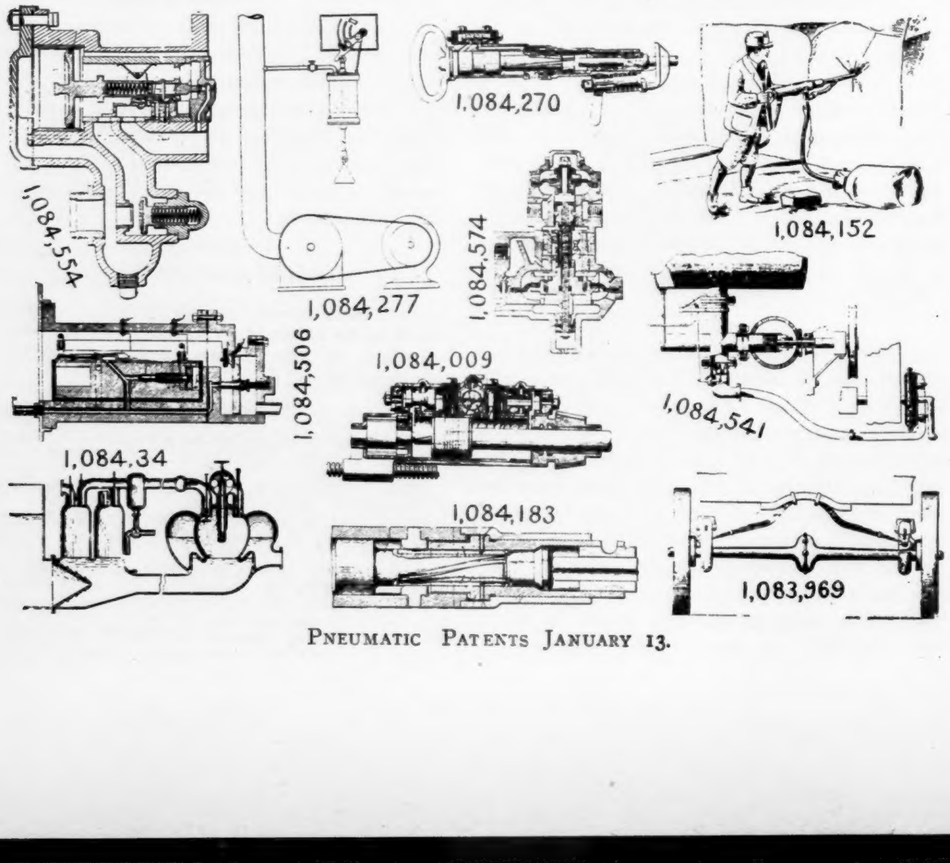
momentarily before the end of the inward stroke of the piston to permit enough air to escape to allow the piston to have a differential inward motion.

1,083,358. VALVE FOR CONTROLLING FLUID-PRESSURE. ROBERT FREER and SAMUEL GREER, Providence, R. I.

1,083,369. PNEUMATIC TOOL. HENRY E. LE GENDRE, Creskill, N. J.

1,083,521. PNEUMATIC BRAKE. FRANCOIS JULES CHAPSAL and ALFRED LOUIS EMILE SAILLOT, Paris, France.

1. In a pneumatic braking system for railway cars and the like, the combination with the train pipe and the local branch of each car, of an accelerator disposed in said branch, said accelerator comprising a casing, diaphragms disposed therein subject on their one face to the pressure



PNEUMATIC PATENTS JANUARY 13.

of the train pipe, and valve mechanism controlled by said diaphragms to control the passage of air to and from the local branch.

1,083,689. FLUID-METER. JOHN W. LEDOUX, Swarthmore, Pa.

1,083,739. CENTRIFUGAL PUMP AND COMPRESSOR OR THE LIKE. HANS GUYER, Zurich, Switzerland.

1,083,758. EXHAUST APPARATUS FOR MINES. BALINT PUSKAS, Windber, Pa.

1,083,761. VALVE FOR JARRING-MACHINES. ROBERT FRANKLIN RINGLE, Zelienople, Pa.

1,083,847. SYSTEM FOR INFLATING PNEUMATIC TIRES. CHARLES P. McDOWELL, WINLOCK, and RICHARD H. EASTER, Elma, Wash.

1,083,891. ACCELERATOR FOR AIR-BRAKES. JOSEPH DE LIPKOWSKI, Paris, France.

JANUARY 13.

1,083,969-70. PNEUMATIC SUSPENSION DEVICE FOR VEHICLES. JOHN WILLIAMSON, New York, N. Y.

1,084,009. FLUID-PRESSURE DRILL. JOHN ALLEN HEANY, Washington, D. C.

1,084,152. DUST-REMOVER FOR ROCK-DRILLS. VILHELM PHILIP KESSEL, San Francisco, Cal.

1,084,183. ROTATING MEANS FOR ROCK-DRILLS. DANIEL S. WAUGH, Denver, Colo.

1,084,270. HAMMER-DRILL. CHARLES C. HANSEN, Easton, Pa.

1,084,277. AUTOMATIC PRESSURE-SWITCH CONTROLLER. CHESTER S. JENNINGS, Boston, Mass.

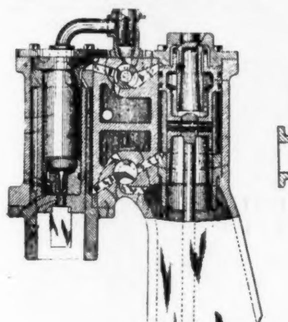
1,084,322. AIR-PUMPING APPARATUS. JOHN J. EVERSON, Newton, Mass.

1,084,340-1. METHOD OF UTILIZING AN EXPANSIVE FORCE. HERBERT ALFRED HUMPHREY, London, England.

1,084,463. MEANS FOR STOPPING TRAINS. WILLIAM T. B. McDONALD, Granby, Quebec, Canada.

1,084,503. AUTOMATIC BRAKE-CONTROLLING DEVICE. GEORGE C. SWEET, U. S. Navy.

1,084,506. ELECTRICALLY-OPERATED AIR-BRAKE. HARRY L. TOOKER, Winslow, Ariz.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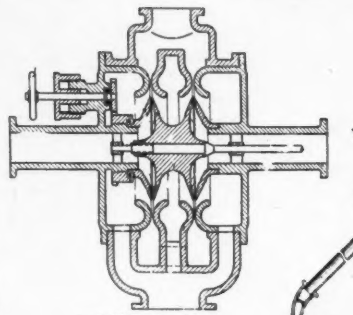
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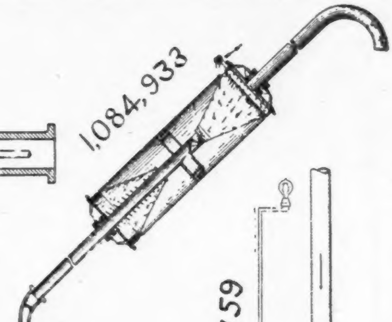
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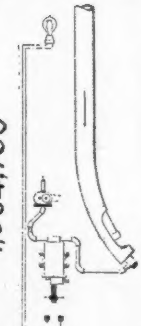
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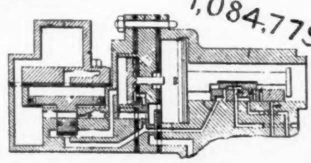
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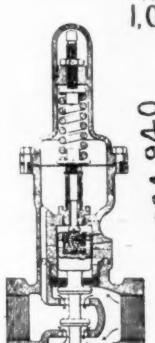
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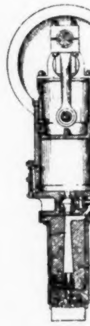
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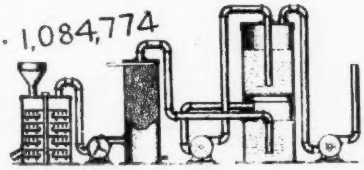
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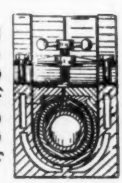

1,084,895

PNEUMATIC PATENTS JANUARY 20.

1,083,971. AIR-BRAKE. GUSTAVE B. WOLF, Smithville, Tex.

1,083,988. PROCESS OF SEPARATION OF THE CONSTITUENTS OF GASEOUS MIXTURES. GEORGE CLAUDE, Paris, France.

1. A method of separation by means of liquefaction compressed and cooled air into liquids rich in oxygen and nitrogen, respectively, consisting in passing it through an upwardly conducting laterally confined space, and then in continuation through a downwardly conducting confined space, and maintaining the downwardly conducting space, and the upper part of the upwardly conducting space at a lower temperature than the lower part of the upwardly conducting space and sufficiently low to cause the liquefaction in those parts of the nitrogen of the gaseous mixture.

1,084,541. EXPLOSIVE-ENGINE-STARTING DEVICE. FREDERICK C. DOODY, St. Onge, S. D.

The combination of air compressing mechanism, a controlling cylinder in communication therewith, a driving wheel, a tubular shaft on which the driving wheel is mounted for rotation, a piston in the controlling cylinder actuated by pressure in one direction, a spring to move the piston in the reverse direction on a diminution of pressure, a rod connected to the piston and extending through the tubular shaft, a clutch member connected to the piston rod and arranged to engage and disengage the driving wheel, and a gear on the tubular shaft connected to and actuating the air compressing mechanism.

1,084,574. COMPRESSED AIR BRAKE. JOSEPH DE LIPKOWSKI, Paris, France.

JANUARY 20.

1,084,689. POWER-HAMMER. RALPH E. BATES, Philadelphia, Pa.

1,084,707. FLUID-POWER HAMMER. JOHN NAZEL and RALPH E. BATES, Philadelphia, Pa.

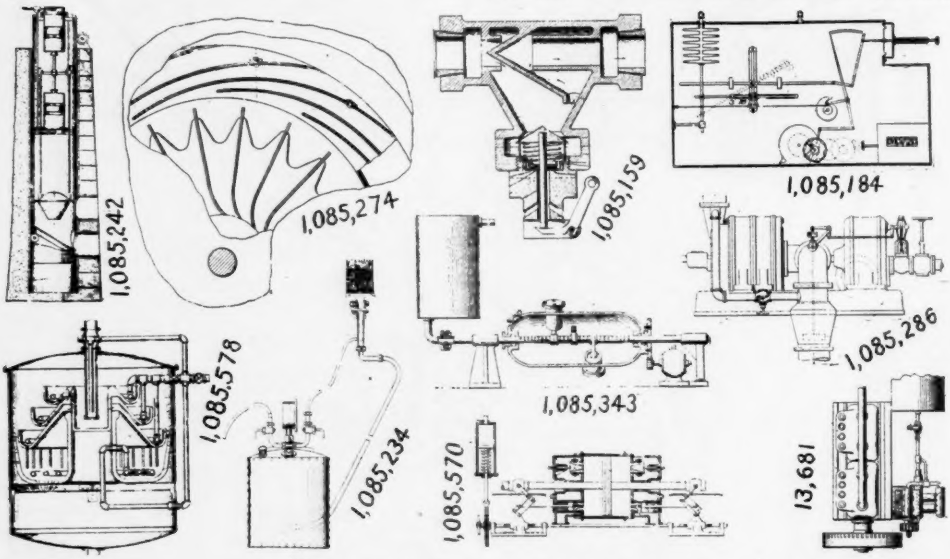
1,084,759. CARRIER - DESPATCH · SYSTEM. FREDERICK L. SOULE, Lowell, Mass.

1,084,774. METHOD OF OBTAINING NITROGEN AND MAKING COMPOUNDS THEREFROM. THOMAS LEOPOLD WILLSON and MAXIMILLIAN MATTHEUS HAFF, Ottawa, Ontario, Canada.

1. The process of obtaining nitrogen from the atmosphere which consists in burning sulfur in a confined body of air and passing the resultant gaseous mixture through a solution containing lime to form a bisulfite liquor and then passing the resultant gas over sulfurous de-oxidizing means.

1,084,779. AUTOMATIC FLUID-BRAKE. LOUIS H. ALBERS, Albany, N. Y.

1,084,895. PNEUMATIC - TIRE - CASING-REPAIR DEVICE. JOSEPH N. NEWSOM, St. Louis, Mo.



PNEUMATIC PATENTS JANUARY 27.

1,084,933. VACUUM-CLEANER. EDMUND J. FEENY, Muncie, Ind.

1,084,940. PRESSURE-REDUCING VALVE. FREDERICK L. JAHN, Philadelphia, Pa.

1,084,955. AUTOMATIC AIR-BRAKE COUPLING. DORCIE R. NUGEN, Auburn, Ind.

1,085,046. APPARATUS FOR COMPRESSING GASES AND VAPORS. GEORG HOLZAPFEL, Essen-on-the-Ruhr, Germany.

1,085,058. PNEUMATIC LOCK. JOHN CLAYTON MESSICK, San Rafael, Cal.

JANUARY 27.

1,085,136. ELASTIC-FLUID TURBINE. WALTER KIESER, Charlottenburg, Germany.

1,085,184. APPARATUS FOR INDICATING AND RECORDING THE FLOW OF FLUIDS. THOMAS R. WEYMOUTH, Oil City, Pa.

1,085,234. SELF-FEEDING PAINT-BRUSH. JAMES ALLAN, Glasgow, Scotland.

1,085,242. WAVE-ACTUATED AIR-COMPRESSOR. SAMUEL CALDWELL, Oakland,, Cal.

1,085,274. DISCHARGE-VANES FOR CENTRIFUGAL COMPRESSORS. LOUIS C. LOEWENSTEIN, Lynn, Mass.

1,085,286. MEANS FOR PREVENTING SURGING IN CENTRIFUGAL COMPRESSORS. SANFORD A. MOSS, Lynn, Mass.

1. In combination, a centrifugal compressor which is subject to surging at light loads, a constant volume governor therefor, and a by-pass for returning fluid to the intake pipe at a point between the governor and compressor whereby the compressor is always loaded to a value above the breakdown point, and all of the fluid entering the compressor acts on said governor.

1,085,343. POWER-TRANSMITTING MECHANISM. OSCAR KECK, New York, N. Y.

1. In a mechanism of the character described, the combination with a support, of a shaft journaled in the support, a horizontally disposed receiving cylinder, loosely held upon the shaft, said cylinder being provided with an intake for the admission of a *fluid under pressure* and having a vent in one of its ends, an auxiliary cylinder provided in the wall of the receiving cylinder and arranged on an angle within said receiving cylinder, a piston movable within the auxiliary cylinder, a crank having one end pivotally connected to the piston and its other end rigidly fastened to the shaft, and means provided upon the receiving cylinder whereby said cylinder may be rotated by a suitable power.

1,085,570. UNLOADING DEVICE. CARL G. SPRADO, Milwaukee, Wis.

1. The combination with a constant speed blowing engine cylinder having inlet and outlet ports, of a piston and piston rod, an auxiliary outlet valve, and a pinned link means for automatically reducing piston motion connecting the piston rod, the auxiliary valve, and the engine frame.

1,085,578. WATER-STERILIZING TANK. SIEGFRIED HELD, Chicago, Ill.

1,085,579. OZONE-GENERATOR. SIEGFRIED HELD, Chicago, Ill.

1. The combination with a tank having an inlet for water in its upper portion and an outlet therefore in its lower part, of a plurality of superimposed channeled members located in the tank and provided with means for the passage of water therefrom, and a separate perforated tubular member located in each of said channeled members and having communication with a *supply of ozonized air.*

13,681 . (Reissue). ENGINE-STARTER. WILLIAM L. STULLER, Detroit, Mich.